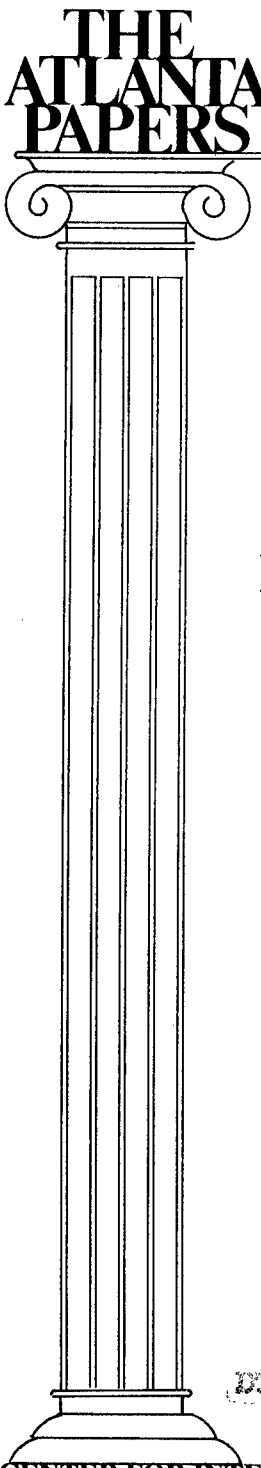

Proceedings 5

The Impact of High Technology on the Physiological & Psychological Dimensions of Warfare

An Army After Next Project Conference

CENTER FOR INTERNATIONAL STRATEGY, TECHNOLOGY & POLICY
GEORGIA INSTITUTE OF TECHNOLOGY

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THE IMPACT OF HIGH TECHNOLOGY ON THE PHYSIOLOGICAL AND PSYCHOLOGICAL DIMENSIONS OF WARFARE

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The Center is also grateful to all those who participated with formal presentations and to the many others whose valuable contributions and thoughtful comments contributed to and stimulated the thinking of the conference.

A final note of thanks is extended to Ms. Umi Harrison for her assistance in transcribing the audio and editing the proceedings.

INTRODUCTION

In the spring of 1996 Dr. Robert Kennedy met with Dr. Earl Tilford, Colonel John O'Shea and Dr. Frank Hurley to discuss the next iteration of U.S. ground forces, Army XXI. Aware of the military's on going effort to creating Force XXI, the discussion centered around the desirability, the need and possible outcomes of examining the Army's requirements for the future and what issues the national security community must take on to insure that the Army and the military are capable of meeting these requirements in a timely manner. The need to define future adversaries and their *modus operandi* soon became evident. Hence the first of a proposed series of Army After Next Conferences, "Beyond the Technological Frontiers of Force XXI" with the focus on identifying WHO the enemy might be and how THEY are likely to fight was conducted in the fall of 1996.

This conference, the second of that series had as its goal an examination of the human factors of fighting as part of the ground forces of the future, and was held in the fall of 1997 in Atlanta. Its title, "The Impact of High Technology on the Physiological and Psychological Dimensions of Warfare," aptly describes its content. These proceedings are derived in large part from audio recordings of the conference or, as noted within, in some few cases are synopses of papers presented.

It is anticipated that additional conferences will be supported by ARO, AWC and TRADOC and devoted to insuring the Army, and ultimately the Force, is capable and ready to meet future challenges on any nature.

THE IMPACT OF HIGH TECHNOLOGY ON THE PHYSIOLOGICAL AND PSYCHOLOGICAL DIMENSIONS OF WARFARE

The Psychology of Leadership and Planning for Army After Next Operations

Leadership Challenges for the Army After Next

Lieutenant General (R) Walter F. Ulmer, Jr. who, after an illustrious military career which was followed by service as President and Chief Executive Officer of the Center for Creative Leadership, an institution devoted to executive development and leadership education, opened the first session by expressing concern at the minor attention given the human factors and the psychology of leadership by the Army After Next (AAN) endeavor and by the research community in general. General Ulmer cited research publications such as the Chief of Staff of the Army's Report on the Army After Next and the even the Proceedings of the 1996 Army After Next Project Conference, "Beyond the Technological Frontiers of Force XXI," noting that, "of the 60 to 70 pages in each document, only one to two pages are devoted to the psychology of leadership." He further noted that in the few documents which do address human factors for consideration in the Army After Next, "ninety per cent is devoted to cognitive or neural areas with maybe ten per cent devoted to behavioral factors. This represents my concern about the Army After Next."

General Ulmer went on to address what he called "obvious connections between the impact of technology changes expected in 'the Third Wave' and the leadership of the future." We must assume for the Army After Next what numerous studies have for years shown, "that the combination of budget austerity and multiple missions, often of great complexity, creates unit stress. Add speed and dispersion of operations - all conducted in full view of CNN, to

decreasing numbers of policymakers who understand the battlefield and its unique demands on human systems and you have a combination providing an enhanced challenge for leaders in the 21st Century." What is not highlighted in these studies, however, is the "extraordinary competition for the high quality people necessary to operate in this particular environment; people who have the emotional stability, the intellectual flexibility, the interpersonal skills and strategic vision to do all the things that we will have to do." General Ulmer believes that "though there may be no data to support my contention that we are seeing a remarkable brain drain in all of the armed forces, we are losing a significant portion of the intellectual talent from Army, Navy, Air Force, Marines, and Coast Guard. I am really uneasy because my sensing is that this is in fact happening and that the captains and the majors in the field share my concern."

This is the environment in which we now find ourselves according to Ulmer: "There is a good job market, there is no massive threat to our economy and, no longer, a massive threat to our physical security. There is an expectation of a great leadership climate and there are families who want to stay together. All of these things will be with us in the AAN environment. The limited awareness that the American public now has of the stresses and the challenges of the military constitutes another factor that we should at least be aware of because, I suspect, such limited awareness means we may not get the support that will permit us to do the kinds of things in terms of structure, motivation, retention, and recruitment that we need to support the Army After Next."

In addressing AAN operations, General Ulmer suggested certain assumptions, such as "CNN is still going to be with us," are likely to be accurate. Likewise, "we are currently *ad hocing* (*sic*) all kinds of joint task forces which, it seems to me, stress the bonds of trust and cohesion essential for efficient, dispersed and fast paced operations." Among other difficulties, data overload in a very high information environment means that "where there is dispersed but simultaneous information about the battlefield, the commander is deprived of one

of the things that he has always had in his hip pocket; access to information that nobody else has, something which, in part, rationalizes his capacity to command. Now the platoon or the ship or the tank will have the same information as the commander, but the commander has made a decision and it may not seem rational to the platoon leader or ship captain. So the question for that subordinate now is, 'what do I do?' I think the answer can only be that if we have not built remarkably strong bonds of trust we are going to have a dispersion on the battlefield that we didn't expect, don't want and can't handle. So, in an environment where we have this simultaneous rapidly dispersed information, we need to have even more coherence, commitment, and mutual trust than we have ever had before, realizing that we are probably in a more stressful environment."

Therefore, according to Ulmer, "local leadership will be even more important with all these technical changes that we see." He further contends, "Leaders will remain the secret ingredient in the combat power equation." US Army War College studies of military professionalism and leadership showed that there were often "tremendous differences" between units next door to each other with the same resources. The only difference was local leadership. "The importance of knowing this has nothing to do with making people feel good. It has everything to do with getting the job done."

General Ulmer feels that 21st Century leaders will have the same purpose as they have today and that the human element has not changed much in 2000 years. The basic needs of humans in formal organizations remains much the same; "AAN leaders must develop trust, focus effort, clarify objectives, inspire confidence, build teams, set the example, sustain a supportive climate, rationalize sacrifice and keep hope alive." His belief is that we are not doing particularly well at teaching, educating, or motivating our senior commanders in terms of their responsibilities to support and sustain the kind of climate that makes people feel like they want to continue to contribute. This is so, he says, "even though there are enough studies done on the difference between the dysfunctional and the supportive climate so

that there should be no great secrets in terms of what these basic responsibilities are; attention to the job, support from above, ability to listen to ideas and so forth."

Ulmer concludes it to be an "apparent reality that Force XXI and AAN discussions, plans, research, field experimentation and funding are heavy on technology, tactical doctrine and organizational structuring but very light on the human dimension of the battlefield ...in spite of our common acknowledgment that people remain the key ingredient." He noted that "the soldiers of the Gulf War who said 'if we gave them our equipment and we had theirs, we still would have won' were probably correct. But its easy for all of us to be fascinated by technology and by strategy. Army people like to talk about technology, strategy, and structure. They like to talk about leadership too, but it's in the different side of the domain. As I mentioned earlier, both the Chief of Staff of the Army's AAN Report and last year's AAN conference proceedings say that the soldier is the key to success but in neither is much time spent pursuing that issue."

As to the leadership implications of the operations assumptions mentioned earlier General Ulmer asked rhetorically:

- "Might public scrutiny inhibit boldness? Of course! Unless we recruit, educate, orient and support a group of commanders who are so secure in what they are doing that they are not looking over their shoulder to the latest CNN poll. By-the-way, that's a hard thing to do. It gets down to some very fundamental things about human nature that we're having some problems with at the present time: political correctness, short term goals, and other kinds of things which may be inhibiting changes that we need to make.

- "What about *ad hoc* task forces and stretching the limits of cohesion and trust? In an environment where turbulence is so great, as it is now in all of our services, it is very difficult to get to know one's companions in the unit. When you then add to that

lashing up with some other outfit, perhaps from some other service or even another country, the idea of trust in the chain of command becomes very crucial.

- "We all know a great deal about decision making and endurance, but this is a leadership problem not only from selection and promotion and assignment, but also from the business of creating those kinds of environments where people can still have new ideas and where the new ideas are respected.

- "When battlefield data are provided simultaneously to all echelons will there be added reason to question senior commanders' tactical decisions? Will the chain of command be compromised? To avoid this there must be increased trust developed before the battle.

- "The question of whether or not leaders can meet subordinates' expectations is significant because commanders have a reduced range for poor decisions. The probability of failure seems to be significant enough in an era when local leadership is so important that it should give us pause as we move into the AAN mode."

General Ulmer followed this by saying "I do not believe we need to search for those leadership characteristics applicable to the AAN. I think the characteristics of good leadership have been with us for a long time, with a few nuances which may have changed, and will remain for a long while. I would say that these things describe the characteristics of good leadership; especially during this time of technology emphasis. Passion is one. Moral courage is another; we've not had much problem with physical courage in the last twenty years but we've had great problems with moral courage; and certainly the cognitive and the emotional business having to do with decision-making agility, some of which may be learned but as much as ninety percent may be genetic; but we know self-awareness can be helped. There must be a sensitivity to things going on about us and there must be a capacity to trust, again, part of which is genetic but part is

learned between the time we are born and the time we are about six years old. Even so, you and I can still form an environment that will facilitate trust, an environment which is essential to empowerment, which is essential to a sense of dispersed responsibility which, I think, is essential on a dispersed rapidly changing battlefield. And finally the commitment to learn and renew ...not learn data, but learn how to learn and learn about ourselves and life is, I believe, a necessary characteristic."

Having talked about what leadership characteristics are needed for the AAN, General Ulmer suggested that we have not yet mastered the psychology of leadership and all that it entails. Noting that the military General Officer and business Chief Executive Officer personalities are about the same, he discussed the managerial profiles derived from hundreds of surveys by the Center for Creative Leadership. He concluded that "the picture of the people who we have now in leadership positions, which is probably a picture of the people we are going to have in these positions in the AAN, unless our selection system and our world changes dramatically, is not bad."

He noted a problem however. "These people are tactically oriented. This plus the current system of efficiency reports and status reports gives us reward for immediate results. It does not give us reward for creating organizational or institutional situations that will perpetuate the goodness of the organization, nor does it reward the 'how to think as opposed to what to think.' So, it seems to me that in our selection and education and promotion systems we need to take a look at the down side as well as the plus side and ameliorate the downside and emphasize the positive parts."

General Ulmer closed with a mention of the Army's newly instituted officer efficiency report. "It's going to help in the coaching of the junior officers in particular. Our senior officers, particularly from major or Navy lieutenant colonel on up, presume that we are all 'ok' because we are always talking about those lieutenants and junior officers that we've got to fix. My bias is that, if we are going to do

the things we need to do, we must fix the colonels and generals as well. So, 'Army After Next' means to me taking a look at the processes of promotion, professional education and selection that can give us the necessary total personnel structure to lead in a period of great stress and great complexity and great situational diversity."

Strategic Planning and the Army After Next

Colonel Joseph R. Cerami from the U.S. Army War College thinks "if we really intend to shape the international environment, respond to present threats and prepare for the future, we need to think about ways to change our national security strategy process, joint operational planning execution system and the planning, programming, and budgeting system." Cerami said he had "watched with interest, as strategic reports and studies, such as the Quadrennial Defense Review, the recent reform initiatives by Secretary of Defense Cohen as well as the Report of the National Defense Panel, were published over the last few years, at how they looked at organizations and how organizations are involved in the making of strategy and planning."

Wondering whether it is good news or bad news for futurists, Cerami quoted from the National Defense Panel's recently published report that had a section on alternative strategies for the 21st century which said, "selecting a strategy appropriate for twenty years hence was not possible or desirable." Cerami, in response, offered a second quote from the document, "...the idea we've got 'to provide a process for developing tools and concepts necessary to implement whatever the most appropriate strategy might be at that time' means we must have organizations capable of developing strategy and planning."

As part of the process, "I think we have to develop a way to connect our organizations to the strategic environment, which we all know is going to be dynamic and have the potential of threats as well as opportunities. Most work I've seen looks at addressing the strategic

environment but not the details of organizational work with regard to long-range strategy and planning. Socio-technical system design gets to the point of trying to put people back into the equation and thinking about the future and getting people to use the new technologies that are coming."

The question of complexity, given the instruments of power that we have to bring together in the interagency process, suggests some impossibility for creating organizations capable of planning for an Army After Next. Cerami feels, though, that there is a possibility of coming up with a systemic thought process, but thinks it has to be tied, with common theoretical framework, into what we believe about war and war fighting. As to these beliefs, Cerami quoted from Clausewitz, "every age had its own kind of war, its own limiting conditions, and its own preconceptions. Every period, therefore, would have its own theory of war...." The idea that each historical period has its own theory of war caused Cerami to wonder what ours would be for the AAN and the Armed Forces after next. "I think there is a potential danger, if we say it's going to be so complex that we have to fragment our efforts into a multitude of rolls and missions for the armed forces, that we could forget our core purpose and priorities. Likewise, if we have an officer corps that looks for engineering solutions to problems, something we tend to see in some of the proposals for organizational change and for development of the strategy and planning processes, we may have difficulty making order of the chaos that we know will be out there. So whether we use a socio-tech system design or some other approach, we can not substitute for flexible and adaptive thinking."

Concerning ways to develop policy, strategy, and planning for the AAN, Cerami noted that conventional wisdom suggests that less than ten percent of corporate strategies are completed or implemented. He went on to suggest that previous efforts at strategic planning have tended to fail because the social systems were not incorporated with the technical systems. Planners would analyze the future, come up with the best things to do and then tell the operational part of the

organization to go ahead and implement it. People routinely failed to execute. So the social systems we are going to need and expect from American society are the key questions that this approach brings up. How are we going to include people in these technical systems?

The socio-technical systems design presented by Colonel Cerami is a chain structure that is an ongoing process where the completion of each of the ten steps he has chosen to include invites input from the previous step. He feels the top four are processes that we do pretty well, and there has been a lot of work done that we can build on. Steps five through nine, though, require a lot of work and there are high costs associated with being able to get this done. It will have to be done by the people who are actually doing the work in the Pentagon and in DC, "which by the way may make it impossible to accomplish. This work is an additional burden at a time when we are cutting the defense and the defense staff. It requires input and active participation of the people doing the work. There is also a problem in implementation, the next to last step. This is the least developed step in the policy cycle in public administration literature. The last step, evaluation and redesign, requires doing something like this as a continuous process. Once again, one cycle won't be enough, which adds to the burden and makes it questionable whether or not the QDR and National Defense Panel would be something that we would do every four years in order to update our strategy and planning. If it is, then we are going to have to institutionalize the process much more so than it is right now."

Socio-Technical Systems Design
1. Define System Scope
2. Determine Environmental Demands
3. Create Vision Statement
4. Educate Organization Members
5. Create Change Structure
6. Socio-tech Analysis of Work
7. Form Redesign Proposals
8. Implementation
9. Evaluate & Redesign

When we change structure, we have to be very careful that we consider the staff connections and we do not rearrange the functions, leaving unintended consequences. As an example of potential

problems related to structure change Cerami cited the redesign of a thirty person office in OSD as outlined in the Defense Reform Initiative Report, November 1997. He asks "Do we really think that the Assistant Secretary of Defense, as smart as he is and as hard-working as his people are, can do all of this? These are major aspects of national security strategy that have been strung together and they simply changed the wiring diagrams and connected some of the blocks and piled on more functions. I'm not sure any work was done on re-engineering to look at the logic and come up with a diagnostic reading of what had to be done in the critical evaluation. Peter Drucker talks about some of these re-engineering designs as amputation followed by diagnosis. Now I'm not sure that was done in this case, but I think it is worthy of being looked at to find out what kind of process they actually did use."

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* Relations with Russia, Ukraine & Other Newly Independent States
* Arms Control

Cerami suggests "an in-depth analysis of all of the characteristics to figure out the best way to revise the system. Having said that, I know that incremental change is probably the only feasible way in the Washington arena. I do not think that the rhetoric of the National Defense Panel and the Defense Reform Initiative will truly transform the organizational structures."

Colonel Cerami closed by reminding the conference that "General Starry, who was instrumental in the Army's institutional change in the 80s, listed the following issues necessary for change: Institution,

Common cultural bias, Spokesman, Consensus, Continuity, Champion, and Trials. Can we do these kinds of things for these echelons above the Army? This may be too hard to do. Many of the elements of that framework, however are in the National Defense Panel Report talking about an institutional basis and trying to come up with a consensus to rebuild and reconstruct the strategy and planning process. What about the next phase of the National Defense Panel. What are you going to do now that you've come up with these ideas? And the answer so far is just to encourage debate, so I think that there is a lot more work to be done in figuring out all aspects of coming up with an institutional base as well as systems for thinking about the future of strategy and planning."

Psychological Changes Needed for Cultural Reform in an Army After Next Force

Dr. Roderick R. Magee holds a faculty position in the Department of Command, Leadership, and Management at the US Army War College. His interests include Strategic Leadership and Organizational Culture Decision Making. He introduced his remarks as a discussion of "organizational culture and how that may be one of the most critical points necessary to consider and deal with to get to any of the proposed benefits of an Army After Next."

It has become axiomatic to talk about the speed of change being the norm in organizations but that discussion tends to be about things - technology, speed, globalization, multi-national organizations *etc.* Magee suggested that "the most important issue, the critical nexus to capitalizing on all this change and to assure the efficiencies and effectiveness that are routinely promised, may be understanding and changing organizational culture," and he noted that "understanding organizational culture is key to understanding both the current organization and how to move it forward, *i.e.* how to change it." It is important to add to this context that changing organizational culture is the province of strategic leaders, those leaders at the top of the organization.

There are several organizational cultural changes which have taken place in the U.S. Army over the past 20 years: officer's clubs offering less drinking, dancing and much less focus for socializing, smoking is no longer the norm, women are included across the board, and even the emphasis on joint operations is an organizational culture change. But they have not come easily and future change, whether involving something as trivial as refusing to authorize umbrellas for male soldiers or the more substantive biases concerning the active components' roles against external enemies and the National Guard's role of maintaining internal order, will likely be difficult as well.

Magee cited some very distinctive characteristics of today's Army which he believes support this position. He said, "It tends to be monastic and paternal, has conservative values, maintains a strong bias for action, considers rites and rituals, values, and care of soldiers to be paramount and, rather surprisingly, uses a very consultative management style at the top levels." These characteristics have helped create a culture in which combat arms are more "important" than support functions, command of a unit is the only ticket to promotion, simulations are practiced only for situations in which there is a known solution, and the easier commissioning of a study will win out over taking action.

In order to meet the Army After Next requirements of efficiency in support operations and effectiveness in combat operations, Magee proposed the need for some very different characteristics within the Army's structure. He addressed "flat organizations, decentralized management, low leader-to-led ratios, direct producer to user distribution, individual specialization and a civilianized contractor work force," for the support side of the AAN. On the combat operations side he described the need for "high leader-to-led ratios, highly trained, multi-skilled soldiers requiring maturity and cohesion, long service and low turnover of personnel, high tooth to tail ratios of deployed forces with mastery of information." This suggests that soldiers will need psychological resilience, cognitive flexibility and organizational adaptability to cope with volatility, uncertainty,

complexity and the speed with which their world will move. It also suggests that leaders "will have to be incredibly perceptive and insightful, have tremendous levels of motivation to stick to things, have emotional strength to manage themselves and others, a willingness to involve others in all aspects of leading the organization and a willingness to share power and control." The bottom line here is that if the organizational needs and competencies required of the Army After Next will be different, then leadership and culture must be as well. All the innovation and creativity described above will be very difficult to achieve in today's Army, a bureaucratic, hierarchical command centered structure.

Having established a need for change, Magee talked to several variables "which facilitate or inhibit reforming the organization's culture - resistance to change, social variables and psychological variables." Most of these variables can be overcome, although Magee expressed concern about the "psychological safety for the top leadership to take the controversial action necessary to implement change without loss of integrity." He also noted that "any sense of urgency felt by top leadership today seemed to be centered around research and development, high technology or alternative technology rather than cultural change."

Magee pointed out three things particularly relevant to the foregoing discussion. Because military forces will remain small, "maximizing efficiency is an overriding need. Undertaking a controlled institutional revolution by deciding what it exists for and recreating itself to accommodate the warfighting function or one or more of the many other functions it might be called upon to perform" must be accomplished. Finally, "where a large army may have been self evident in the past, senior leaders will have to persistently and convincingly explain the roles of the Army, the value added to a society that has less and less exposure and experience with it."

In conclusion Magee said, "Leaders in the current environment must think as change agents. Leaders must have the emotional strength to

be supportive of the organization while it deals with unlearning what was previously successful. Finally, leaders must notice changes in the environment and then figure out what needs to be done to remain adaptive. The Army must question its basic assumptions, a critical thinking skill, and take necessary actions to embed the changes necessary."

Questions & Answers

Colonel Rich Payne, from TRADOC, asked General Ulmer how the Army should "approach identifying and promoting officers who will not only know the institutional side of the Army, but the technical and tactical aspects as well, to positions of senior leadership?" Payne noted, "this is an issue in our planning for OPMS XXI (Officer Personnel Management System XXI)."

General Ulmer explained that "OPMS XXI is an Army plan for personnel management that provides three or four collective career stovepipe patterns within which one can move up the ladder and, *de facto,* not compete with the other career patterns for promotion. The fundamental problem that the Army has today in retaining certain kinds of talent is that if you are an unsuccessful battalion commander, you probably are not going to make colonel. We have in the Army many good officers who probably should have never been battalion commanders but who would make great colonels and who would do well those things needed of colonels. OPMS XXI is designed to take advantage of this.

The question this brings up is will the Army go back to a first class and second class officer corps such as it had at one time between the regular and the reserve people on active duty. There has always been some sort of a gap between professional branches in the Army - the chaplains and the medical people and the lawyers and other kinds of officers. If the Army is not really careful, it will have a 'we are the warrior folks who are the real soldiers' mentality and then there are

all those other folks out there. I think that's just one of the necessary downsides of this new system which will permit people to move up the ladder without going through this very narrow and sometimes inappropriate screening of battalion tactical command. I think today that there is an increasing difference in the climate and the culture between the combat service support and the combat parts of the Army. I think our challenge is to figure out how to create a sense of overall cohesion while still moving toward the compartmental approaches of OPMS XXI because I don't think there is any other solution. The current 'everyone through command to be a good guy thing' is broken, and it's just not doing what it needs to do."

Bill Cunningham, also from Headquarters TRADOC, observed that significant cultural change in our country suggests that when the AAN comes around we will have a very different paradigm about learning and adapting. Cunningham questioned the impact of such a change on the military leadership.

General Ulmer responded "we have, collectively, the capacity to keep the institutional values as about what they should be if we can practice what we preach. It's the senior people in any organization. The organization either does well or it doesn't, depending on the collective insight and leadership of the top team of the organization. I would also say that there are lots of cultural changes in this society which are going to have an impact. One of the most important would be the expectations that the younger soldiers or officers are going to have. One of the things about this current generation is they expect and want more understanding as to why they are being asked to do certain things, and more influence in the decision making process. I think the expectations of people in organizations are that there is a tremendous amount of knowledge across the organization and that the only way you are going to make use of it all is to have collaborative work and collaborative leadership. I think that is going to be one of the things coming out of society in general. People's expectations are going to have to be considered."

Referring to the discussion of horizontal organizations, Ulmer said, "I'm one of the few people in the world who believes that it's not really happening now and that its never going to happen. Most organizations are going to be hierarchical in certain domains and the issue is that the Army must have firm command and control on one hand and remarkable organizational resilience on the other such that it can generate creativity and innovation. That is possible to do if you educate the people and reward the commanders for setting that type of an environment."

Preparing for the High Tech Battlefield

Colonel Steve Wesbrook, Executive Officer to the U.S. Forces Command Commander, introduced this panel's look at the future battlefield, noting the need to address three dimensions. The first is anticipating the battlefield or the battlespace, the second is anticipating the training and personnel performance issues that affect soldiers as they get ready for that battlefield and, finally, anticipating how the warriors will respond on that battlefield in the next century.

Colonel Wesbrook said "throughout these presentations the central thread will be the human dimension, whether it's a reminder that war gaming, like war itself, is not necessarily a mechanistic process, but that the enemy does get a vote, or whether it's a look at the warrior spirit and the individual responses in the face of battle."

The Role and Limitations of Wargaming in Preparing for the Battlefield of 2025

Dr. Jonathan Lockwood, an adjunct professor at the Joint Military Intelligence College who has published extensively in the fields of intelligence analysis, war games and strategic doctrine, military history, and Eurasian affairs, including the book The Russian View of US Strategy, noted that, "as a participant in the most recent Army After Next Winter Wargame (AANWWG), I found myself in a unique position. Having been an intelligence officer in both the active and reserve components of the US Army since 1977, participating as a member of the RED Policy-Strategy cell provided an interesting challenge. I believe we uncovered insights which illustrate both the usefulness and limitations of wargaming as a tool for preparing ourselves to meet the challenges of the future battlefield of 2025."

The AANWWG was the first global strategic "free play" wargame designed to discover significant issues concerning the nature of future warfare in 2020 and beyond. As a free play wargame, the players were unconstrained by any scripted or predetermined outcome. Participants were free to devise their own strategies and approaches in order to achieve their perceived national goals, in this case, in 2020.

Dr. Lockwood described the aim of the AANWWG to be "to create a wargame whose participants could replicate, as realistically as possible, the perceptions and viewpoints of the national actors in 2020." Because a primary purpose of the wargame was to test the viability of BLUE's information dominance strategy and high tech battleforce units, only the BLUE side was simulated in great detail, with RED and PINK portrayed to a lesser degree. The wargame used a postulated 'future history' of events leading up to military confrontation in 2020 between RED and BLUE. Such events as the incorporation of Poland, Hungary, and the Czech Republic into NATO membership were virtual givens, while the additional incorporation of Slovakia into NATO and the absorption of Belarus into RED as an autonomous republic were considered logical extrapolations from the present.

Insofar as the warfighting capabilities of the major protagonists were concerned, the designers used the same sort of straight-line extrapolation, with minor exceptions. Militarily, BLUE was considered to be the only high-tech superpower, while RED and PINK were considered regional near peers with comparable but inferior capabilities. The crucial assumption of BLUE's information dominance strategy was that it would have uncontested superiority in space. Lockwood noted, "This assumption would later prove to be a decisive influence on the course and outcome of the wargame as both RED and BLUE possessed considerable capability for space denial notwithstanding BLUE's acknowledged overall superiority."

Lockwood felt that "The initial intelligence assessments of both sides had a decisive effect an their initial courses of action." He summed up their initial thinking as follows: "BLUE estimated that RED was preparing for an offensive against Poland in response to Polish agitation of Belarusian nationals. RED concluded that a direct war against a BLUE-NATO alliance would be suicidal, and instead responded to Polish agitation by occupying Belarus with its military forces. In actions that were further contrary to BLUE expectations, RED opted for a limited war against Ukraine coupled with a simultaneous preemptive strike in space at the outset of the war in

order to nullify BLUE's space superiority and reduce BLUE's ability to respond quickly to RED's invasion of Ukraine. This was because of RED's assessment that BLUE's dependence on satellites for its information dominance strategy was the crucial 'center of gravity' for BLUE. Achieving strategic surprise in space offered the only real opportunity for RED to obtain an early asymmetric advantage over BLUE."

"RED's preemptive strike in space and invasion of Ukraine achieved virtually complete strategic surprise," according to Lockwood, "paralyzing BLUE both politically and militarily. BLUE intelligence assessments had not admitted even the possibility of such a combination of actions. Part of this could be attributed to complacency on the part of BLUE. Indeed, in pregame briefings the prevailing underlying attitude seemed to be that the validation of BLUE's information dominance strategy and force structure was all but a foregone conclusion." Unfortunately, few of the BLUE participants remembered or heeded Clausewitz's admonition that "war, however, is not the action of a living force upon a lifeless mass ...but always the collision of two living forces."

"The strategic surprise also had its affect on BLUE's NATO allies. By deliberately waging a limited war against Ukraine which was not a NATO member, RED had succeeded in driving a wedge between BLUE and its NATO allies. Because Article Five of the NATO Charter had not been invoked the NATO allies were unwilling to provide airbase support to BLUE for any unilateral counteroffensive in Ukraine. This created the first real "crisis" in the Winter Wargame. Not only had RED undermined the heart of BLUE's information dominance strategy by achieving virtual parity in space with BLUE in the first 24 hours, RED's preemptive strike/limited war strategy was threatening to win the Winter Wargame immediately. Not only would such an event have been politically and publicly embarrassing, it would have forced the adherents of BLUE's high tech strategy and force structure to rethink their entire approach, if not abandon it altogether. The wargame controllers were forced to intervene by introducing certain

'artificialities' in order to prevent RED from winning the wargame outright. One of these artificialities was compelling NATO to provide airbases to BLUE to support its unilateral intervention against RED in Ukraine. Another involved continuing to compute the combat values of BLUE as if it still possessed superiority in space, rather than the parity that actually existed."

The follow-on according to Lockwood was that, "Faced with a war in space that it had never anticipated, BLUE responded in the only way left to it, by mounting a counteroffensive in space to reduce RED's assets for space operations and space denial. This was accompanied by Special Operations Forces (SOF) attacks against ground-based space operations targets in the RED homeland. It must be pointed out at this juncture that both sides possessed systems admirably suited for a strategy of space denial, but badly designed for a space control strategy. Given this array of systems, the only way a space control strategy could be executed successfully would be to adopt a policy of preemptive strike in a crisis. For BLUE, such an approach was deemed politically unacceptable; the same, however, did not hold true for RED."

BLUE's counteroffensive in space eventually enabled it to regain a measure of superiority by steadily reducing RED's space assets. Additionally, aided by the aforementioned intervention, BLUE was eventually able to defeat RED's invasion of Ukraine. The reaction of RED's leadership once again caught BLUE by surprise. In a desperate effort to stave off total defeat and force BLUE to halt its ground offensive, RED detonated a number of high-yield nuclear weapons in low-earth orbit. This effectively destroyed most of the world's military and commercial satellites. Lockwood postulated that "the rationale for this desperate maneuver was even if every satellite in space is destroyed it hurts BLUE more than it hurts RED because BLUE depends more on its satellites to carry out its style of warfare."

Even though BLUE had succeeded in driving RED out of Ukraine, the chaos resulting from the near universal destruction of space assets

compelled both RED and BLUE to negotiate a ceasefire in the West, which promptly took effect. Although BLUE technically 'won' the wargame, the military lessons of the AANWWG include the general, if only tacit, recognition by the participants in the subsequent seminar "that it had been a Pyrrhic victory, both because of the rapid escalation of the conflict and the extensive destruction of the world's space assets. Moreover, all participants acknowledged that space control is vital to any BLUE 'information dominance' strategy, although it was not clear to any present how such a space control capability could be achieved or maintained, given RED's successful preemptive strike."

Both the Seminar report and the later Integrated Analysis Report by TRADOC conceded that "a preemptive strike strategy in space offers asymmetric advantages to RED which BLUE found difficult to anticipate or overcome. In particular, RED's 'Samson in the Temple' maneuver of using nuclear weapons to render space unusable to both sides for an indefinite period was especially troublesome as it offered the possibility of attaining space superiority to the side better able to reconstitute its space assets through superior launch capability, which in this case happened to be RED."

"For advocates of a space control doctrine," Lockwood warned, "the results of the Winter Wargame provided scant comfort, since the existence of space denial systems in significant numbers on both sides created a 'hair-trigger' prewar situation in space, with enormous incentives to preempt in a crisis situation. As a consequence, uncontested space control on the future battlefield cannot be assumed as a given. An enterprising opponent, even if technologically inferior, can still achieve strategic surprise through the timely use of preemptive strikes against BLUE's center of gravity, its space systems. RED's successful preemptive strike in space poses a critical problem, both for future BLUE warfighting doctrine as well as strategic intelligence, since it will place a very high premium on timely indications and warning. Even with timely strategic warning, BLUE's disinclination to adopt a preemptive strike posture in space is

a serious long-term vulnerability open to exploitation by any potential opponent, near-peer or otherwise, since it concedes the strategic initiative in every future war to the opponent."

Lockwood feels that, "Even though some observers tried to downplay BLUE's space vulnerability by asserting that no other country could afford the high technology space denial systems postulated for RED in 2020, this overlooks the fact that the nuclear attacks in space were relatively far more damaging to BLUE's capabilities. Moreover, the nuclear attacks in space created a situation which went beyond the scope of the wargame, namely the global economic collapse which would result from the destruction of most of the world's a commercial space systems. Even today, such sudden wholesale destruction of space systems would have devastating economic impact; in 2020, it could be catastrophic."

Finally, Lockwood suggested, "The events of the Winter Wargame foreshadow the ultimate danger inherent in nuclear and ballistic missile proliferation; that any near peer competitor or Third World country acquiring such capabilities will be able not only to exploit BLUE's most visible weakness in time of crisis or war, but also to hold the world's economy at risk. Given the potentially far-reaching consequences of our hypothetical future war in space, the political and economic implications for both intelligence and defense spending are immense."

Although future iterations of the AANWWG will no doubt teach additional lessons, Lockwood closed by identifying the following as "probably the most obvious lessons to be drawn regarding the utility of wargaming as a tool for preparing for our postulated 2025 battlefield:

1. Wargames are only as good as the people who play them. One of the positive benefits of the Army Winter Wargame was that it brought together a large number of people with considerable collective and wide-ranging expertise, and provided a format in which they could

use their knowledge, experience, and creativity; a "free-play" wargame with no predetermined outcome. In order for wargames to have any utility at all, they must be conducted with the most skilled people you can get. Otherwise, we may find ourselves basing future strategy and defense spending on the assumption of an improbably foolish or passive opponent.

2. Beware of the hidden agenda. If we are going to conduct a 'futuristic' wargame at all, we have to he very honest about our motives and willing to accept the validity of the outcome, even if it conflicts with what we wanted to have happen. When the results of the Winter Wargame challenged the prevailing assumptions there was clear consternation among some senior leaders in the Army, followed by attempts to downplay the significance of the results. If we wish to invest the time and resources to conduct this style of wargame then we must also have the courage to face its outcomes.

3. Wargames, assuming they are skillfully conducted by the participants (and that we heed lesson number two above), can reveal hidden flaws in strategies and force structures. What they should also teach us in that there is no such thing as a perfect plan, an invincible strategy, or even an optimum force structure. Depending on the political goals of the combatants, the nature of the international environment, and even the state of domestic political conditions, a resourceful, motivated opponent can find an asymmetric response to almost any strategy or force structure, save the most prohibitively expensive ones.

4. Good wargames provide unanticipated insights which go beyond their intended scope. The destruction of most of the world's space assets in the Winter Wargame created an unanticipated consequence which went far beyond the scope of what it was designed to simulate; namely the global economic collapse which would doubtless result from the sudden loss of space assets on which the future world economy will have become increasingly dependent. If such unanticipated results do not themselves provide the basis for future

wargames, they at least provide considerable food for thought for our military and political leadership."

The Psychology of Selection and Training for the Battlefield of 2025

Dr. Scott Graham from the US Army Research Institute (ARI) facility at Fort Benning, Georgia addressed ARI ideas about the future, both before the AAN and into the AAN era, with respect to training and personnel performance issues. He qualified his remarks by noting, "We talk about what we know about these things but we really don't know; it's our best guess based on several decades of research in the human resources arena and we simply try to pull together some of the lessons we've learned. I'm also going to identify some issues that we think need to be looked at in terms of research."

A systems approach to looking at training and personnel performance issues involves several themes such as sequential selection, assignment and training, all of which rely heavily on building virtual and constructive environments that allow us to test some of these items. In these environments, ARI hopes to do virtual prototyping of both equipment and the human factors such as communications patterns, tactics, procedures, and effective job structures.

Dr. Graham made certain assumptions for the AAN. "Certainly the AAN is going to be a significantly smaller force, and it's going to be required to defeat enemies across a full spectrum of operations. One of the main ways to do that is by driving up the tempo. A second is to require leaders and soldiers to manage high tech assets; intelligence assets, sensors, unmanned vehicles, and remote precision fires."

Additionally, addressing the complexity in the future battlefield is not just the difficulty of bringing steel on target, but the complexity in dealing with organizational factors or cultures such as CNN. "That is," Graham said, "we must win the war as well as the battle."

The final point is that, despite all this futuristic talk and the fun from thinking about these small high tech forces, military history, according to Graham, "has told us that, in the end, we have to close with the enemy; that will continue to be the Army's role."

The human and organizational requirements that soldiers, units, and leaders will need include psychological resilience, flexibility, and adaptability. This is because a company or a battalion that plans and rehearses highly appropriate courses of action in the morning may, as the rules of engagement change within a couple hours, find them very inappropriate by mid-day. Graham says "we need extraordinarily competent units and leaders who have the ability to make complex discriminations." People are going to be faced with information from their displays which conflicts with other information received such that soldier operators will be saying "... my technology is telling me this, my brigade commander is telling me that, what I see on the ground in front of me suggests strongly I ought to be doing a third thing." How do we develop people who have those skills to apply the principles of war? How do we have a system which reinforces people for doing that? That's one of the tough challenges.

Graham addressed a framework of human resource research issues organized around what he called the Army life cycle. "First," he said, "the Army must agree on some sort of baseline for future missions so that we can conduct research using virtual prototypes. A key issue is going to be the question of modular units. The Army is going to have to develop and try out some procedures for scaleable units. As we put these units together and bring in support operations, reserve components, military contractors, and even other nations, how can we build a cohesive unit that performs well?"

Additional research issues include centralized versus decentralized command and control. "We talk about empowering smaller units to make these decisions and to act on their own in this quickly changing battlefield. On the other hand, the communications electronics will allow leaders to know what is going on in near real time. Likewise,

what about developing generalists versus developing specialists or what about flat organizations or the organizational factors that influence flexibility and rigidity?"

Graham talked next about selection and assignment. "The special forces community has been developing a sequential testing and assignment procedure. They now have the Special Forces Assessment and Selection Course where candidates who are interested in special forces are tested. Those who make it through the screen go on to the Military Occupational Specialty qualifying courses. It would be possible to develop some type of similar scheme for the AAN forces. ARI has begun a research project to look at what attributes are needed in the 21st century NCO. The top attributes include integrity, discipline, motivation, intelligence and adaptability. These are qualities defined by senior noncommissioned officers and are what NCO's themselves see as being important to the 21st century.

Training is also central to the theme. ARI believes that many of the situations the AAN puts forward - complexity, having to manage huge amounts of information, bringing in remote precision fires - can really be addressed by the extension of current training procedures. "One of the things we know," according to Graham, "is that you need to train in a functional context. The Army uses the expression, 'Train as you'll fight.' As we get to 2005 or 2010 and these environments become clearer, let's put these units into immersive training situations that give them repeated practice in increasingly difficult tasks; tasks which require them to be flexible and to be adaptable. Part of the preliminary results from the Division Advanced War Fighting Experiment is that, towards the end, the division staff jelled and reached a 'hyper' of high efficiency so that they were able to take all this high technology information and really 'clean the clocks' of the world class X-Forces."

How can we develop these super confident people that are highly proficient? How do we get there, how long does it take, how do we train people to be tactical and strategic at the same time? One of the

ways may be in the development of virtual environments to include constructive simulation in war games. The critical thing is that these environments have to include these characteristics and attributes of the AAN battlefield. Most likely these environments are going to have to include realistic representation of sensors and other national intelligence assets. They must also represent the physical and psychological factors associated with continuous operations in the AAN. Virtual emulations of modular unit leadership brings up interesting questions. When are we going to put these pieces together? Can we, in our constructive models in the war games, include the patterns, thought processes and personalities of perhaps a reserve component supporting unit? Can we construct these virtual environments?

Another issue is that it is going to be more of a dove tail between training and mission rehearsal. If we can develop these realistic virtual environments to train generalizable skills, then as it gets closer to mission time, we can plug in the mission specifics and go into rehearsal mode.

Having suggested the need, Dr. Graham then talked to "the current state of virtual environments as we see it. What is it that you want the technology to do? Generally the technologies are not near being able to create these environments. Can you take these soldiers, put them into these futuristic environments, can you get the soldier in the loop and learn some lessons from those? This has been done pretty successfully. We learned the value of the soldier in the loop. We learned the value of some of these displays, but again the big thing here is that simulation was hampered by present day technologies. One of the problems is that the funding is getting ever tighter. There is even some discussion about cutting the funding for developing these future virtual environments because they don't do what they are supposed to do. If we don't fund these things then it's going to be difficult to get to where we want to be."

The final issue is "how can the Army take today's relatively fixed structure of ten divisions with its fixed tables of organization and develop an assignment system to meet the flexibility needs? You would take soldiers and units and track their skills and abilities so that we know what they are capable of doing. Then, as the Army's requirements change, you can direct them towards the needs of the Army. It may be possible to have a prescriptive strategy whereby you would take an individual, say an armor crewman, and have a profile of training, education, and abilities this person possesses and if we need to move this person into a prevention force we would know what knowledge, skills and abilities are there. Likewise it might be possible to know what if any specific additional training this person needs.

One of the critical parts and most difficult issues, as this personnel and training system is developed, is to know if we are really addressing the toughest conditions in the AAN. We need to have performance measures. If we are trying to measure leadership, adaptability and flexibility in the context of collective performance, then what we need to do also is develop performance measures that address that. We have a proficiency assessment system which may help active component and reserve component integration. If we have an AAN team or a battlestaff and if we have an assessment system that accurately allows certification of warfighting capability, a system everybody believes in and in which all believe that the same criteria apply to active components and reserve components, then that would help build trust and integration.

In summary, Graham feels strongly that "training and personnel performance issues should be systematically addressed across the Army life cycle. The Army's development of doctrine, organization, training, leaders, material and soldiers should focus more on training, leaders, and soldiers. Too much of today's emphasis is on material development." One final point made by Graham was that the Army needs a unified champion or proponent for 'Human Dimension' issues both for the nearer term and for the AAN. This of course implies adequate 'Human Dimension' research funding."

The Warrior Spirit in a Changing World of Battle

Doctor (Colonel) David R. Jones, a former Air Force flight surgeon and former Editor-in-Chief of the journal of the Aerospace Medical Association, *Aviation, Space and Environmental Medicine*, and currently a Clinical Professor of Psychiatry at the Uniformed Services University of the Health Sciences, said, "we see the rate of change in warfare picking up in parallel with the rate of change in technology, which makes predictions of the war of the future look more or less like science fiction."

According to Jones, all humans seem to be motivated along lines somewhat like the classical theoretical hierarchy that Maslow listed in 1943. This hierarchy begins with the basic biological necessities of air, food, water, thermal control, shelter, sex, and rest and then ascends through the assurance of personal and family safety into the sense of love and affiliation. Next comes a need for self esteem and the approval of others whose opinions we value, followed by a need for meaning, order, and predictability in the world around us, then into an impulse toward the aesthetic appreciation of beauty and balance and finally the attainment of the sense of accomplishment of the limits that we can personally attain, even to influencing others towards similar personal goals of excellence themselves.

Dr. Jones noted that, "In the combat setting, the psychological necessities, above the level of the basic biological requirements in creature comforts, include the horizontal security of unit cohesion and of small group morale as well as the vertical cohesion of connecting with the source of power larger than the group. This must be a power that will be dependable, concerned, and sustaining. In dangerous situations, there must be some sense that one is valued, that one is not alone and will not be abandoned or forgotten. One tries to establish a sense of control over one's fate in battle even through irrational superstitions or rituals. One needs a sense that the cause is worth fighting for and, in an altruistic sense, that this worthy cause has some chance of success even if it enlists the ultimate personal sacrifice."

Jones described the current task as being "to predict the rapidly evolving technology of warfare that will be in existence thirty years from now, speculated on by its effects on a culture that is changing from year to year, to consider how these technological and cultural changes will modify that portion of our society that furnishes us the ground soldiers, to mull over possible missions, and then to prophesy about how these factors will interact with the intangible elements of individual and small group behavior that we call the 'warrior spirit.' It is quite an undertaking."

Jones further noted that history teaches that one may predict the behaviors of groups of warriors with some confidence but not the behavior of an individual warrior.

He then discussed analogies to be drawn between what is known about pilots today and some of the factors the future ground soldiers may face in the 21st century battlefields. He said, "Situations include technical weapons systems which require great personal skill to operate, extensive survival and personal support equipment, physical stress such as jet lag, altitude, time zones and so on. Additionally, the occasional use of behavior modifying medication, isolation on the battlefield, hot mike communications with several units of command, threats of highly lethal weapons so that both skill and luck are needed to survive the war, having no place to hide in a deadly environment, leaving one to depend on speed, mobility, and fire power may be similar situations."

The things which have nourished and supported the fighter pilot spirit in such a combat environment include being managed by a finely tuned system of selection, training, and evaluation. Their physical and mental status are carefully evaluated and the necessary psycho-motor skills are the subject of extensive ongoing research. As the selection criteria requires an increasing number of skills, it becomes more difficult to find the person who has them all, so the manpower pool shrinks as you require more of it. Today's pilots receive technical support of the highest quality provided by specialists in

personnel, equipment, survival, maintenance, avionics, and medicine. The tail-to-tooth ratio may be high, but in an air base environment where pilots are seen everyday, mission support personnel understand the priorities and most of them take a great deal of pride in being individual contributors, as 'behind the lines guys,' to the efforts of the pilots. The highly visible warriors, the aviators, are generally admired by those who back them up. The major question asked by Jones was "Can this attitude be cultivated and nourished in the Army of the future?"

The assurance of top-notch medical care has, according to Jones, always been high on the list of morale factors for ground soldiers. The technological battlefield of the future should be able to match advances in weaponry with advances in medical care. In the US Air Force, personalized medical care is furnished by flight surgeons who also may fly as observers on some missions. This system, in which physicians serve in the same ways as physical trainers or athletic trainers, has been adopted by many Air Forces around the world and is of particular value. This extends far beyond the traditional role of the enlisted medical corpsmen, the medic who lives and works with the combat ground troops. Medical doctrine in the battlefield of the future emphasizes the swift employment of highly specialized medical care from the moment the soldier is wounded. Current plans call for rapid forward stabilization of casualties by physicians, surpassing the level of care given by emergency medical technicians to civilians. This could mean carrying a portable plastic envelope and putting it over the wounded soldier and performing surgery before you pick him up. Forward surgery, portable life support equipment, on the spot ultrasound scans read through tele-medicine links with the rear and other such innovations are currently in use and their effectiveness has been demonstrated. Additional advances such as individual vital signs monitors and transmitters are in prospect.

In another area, sedative and stimulant medications are used when necessary for safety on flying mission completion. This has always been controversial and occasionally it has been political, but has been

safe and effective when done in a professional and reasoned manner. "In a sentence," Jones said, "the use of such medicines is indicated when it is more hazardous not to use them than it is to use them. Acknowledging their hazards, there are times when it is worse not to use them than it is to go ahead and use them."

In aerial warfare, constant communication is the substitute for the absence of physical closeness with comrades. Within the aircraft flown by crews, a constantly hot microphone is available. In other aircraft, the push of a button puts any pilot in contact with companions on the flight, or the mission leader or the headquarters command post. Such a system may be used as an antidote for the increasing isolation of the battlefield of the future. Soldiers are becoming more isolated through physical dispersion. They may also be personally isolated in protective gear and thus are less able to draw strength from their comrades. The anonymity of chemical protective clothing and the difficulty in communicating by word, or even by nonverbal gestures or posture, are examples of this isolation. As individuals become more alone in battle, they will seek the comfort of the presence of others in any way that they can and individualized communication systems will be a powerful morale booster. Yet there are negative concerns according to Jones. What will be the effects on morale when a soldiers last moments are vicariously experienced by hot mike radio transmissions and by watching the readouts of vital signs as comrades die?

Discussions of the warrior spirit must contain information about group morale, unit cohesion, and the horizontal and vertical bonding previously mentioned. The individual pilot, in combat, must be able to depend upon comrades who can and will support him to the limits of the possible and, at times, beyond. His commanders and leaders are pilots too, and they fly some of the same missions as he does. They will not send him where they would not go themselves. If he is shot down, the Air Force will spare no effort to recover him. The analogy to the isolated ground soldier on the future battlefield, no matter how technical it becomes, is clear.

Within small groups of soldiers there must be absolute conviction that rapid and difficult decisions made in the heat of the moment will be supported by the chain of command. This means that the soldiers at the scene believe that the decisions they make are right and respected. From the commanders point of view, this means that the group must know how to make the right decisions, however you define them. This may be achieved along the usual continuum of command styles ranging from the authoritative to the participatory, but requires a careful balance between over management, resulting from improved monitoring and communications, and the need to be able to delegate authority with confidence.

Uncertainty about missions will undoubtedly continue in the AAN. The warrior of the future will face a spectral of violence extending from routine garrison duties through peace keeping, peace making, combating terrorists, to fighting low or high intensity war. These situations will require a variety of skills and attitudes some of which are not interchangeable. The civilian who makes a good fire fighter or para-rescue technician many have no desire and little ability to be a police officer and *vice versa*. Likewise, there is currently considerable disagreement as to whether soldiers can be simultaneously skilled as lethal warriors and as empathetic peace keepers.

Jones asked rhetorically, "Who will be the warriors of the future? As with pilots, the description of the average soldier has changed a great deal during my lifetime and appears to be changing still. It is difficult to predict who will be making up the Army thirty years from now. Some of the questions... What proportions of ages? What proportion of men and women? What cultures? What races? What religions? Are these people going to be citizens or immigrants hoping to obtain citizenship? Are they going to be basically English speaking or increasingly polyglot? What will be their family relationships? Are they more likely to be married, single, with or without children, with a spouse in the service or not? Will the Army service be seen as a career or just as an episode in a life involving other plans?"

Jones suggested that "Such issues will be crucial elements influencing recruitment, morale, and retention. Each of these factors will in turn become more critical as the technical training for the weapon system of the future becomes more extensive and expensive. The Air Force is currently wrestling with retention issues affecting its highly trained pilots and the Army should, I believe, watch this matter carefully."

"Considerations like this bring us to more questions about whether the warrior spirit can coexist with the spirit of peace keeping and peace making," according to Jones. "Are the skills required for these identical, complementary, or opposite? Can one individual manage them all? How will it be manifested in a peacetime army? How will they figure in career progression? If the army promotes the right person, how will the Army know it? How will the Army recognize the warrior spirit when it is present in peacetime? How does peacetime Army reward the warrior spirit? What peacetime skills may be incompatible with the peacetime Army? What command decisions must be made that will affect the desired warrior spirit? What political pressures will affect these decisions in ways detrimental to the warrior spirit?"

"Fortunately for me," Jones said, "these questions extend far beyond the scope of what I can talk about, so I don't have to try to answer them. Yet, as I was preparing this talk, these issues were continually at my elbow jostling for my attention and trying to get into my discussion."

"So in conclusion, I would charge you to ask the tough questions now and look for ways to validate the answer. If this conference came to the perfect conclusion about the army of 2025, how would you know it? Realize that a future civilian or military official may, with less than a minutes consideration, make an uninformed but totally binding decision about issues that some of you have spent months or years or your entire career considering and he may make the wrong decision. Challenge the imposition of policies made with no data to back them up. Do not confuse hypotheses with facts. Look for the unspoken

rules. They must not be ignored in consideration of the Army of the future. Above all, remember that the human being who is doing the fighting has the same basic biological and emotional makeup as have all soldiers throughout history. No matter how fascinating or reassuring a technological advance or a novel policy seems to be, someone should always be there asking, 'how will this affect the soldier' who will be there when it is being used?"

Questions & Answers

The Army Research Institute representative took exception to Dr. Jones comment that soldiers have the same emotional attributes they always have had. The ARI representative suggested that emotions change as much as facts do, therefore Dr. Jones' conclusion concerning psychological necessities was incorrect.

Jones responded that he "was thinking about what I consider the truly basic emotions of shame, guilt, fear, anxiety, and joy that feel the same as they always have felt. A person who is afraid *feels*, and I mean literally, *feels,* what the autonomic nervous system feeds into that individual, and I think that hasn't changed over the past years. Now, what makes him feel that way may change. Especially when you get into the business of anxiety, you get into embarrassment and being ashamed in front of comrades and so on. That sort of thing may change. When you get into the psycho-physiology of the emotions people are pretty much the same. What makes them feel that way may be different."

Dr. Mel Steely, from the University of West Georgia, noted that unit cohesiveness is credited with being the thing that gets soldiers through the "god-awful conditions that they have to survive whether it was the Civil War, the Battle of the Bulge or Vietnam." He asked the panelists' opinions "on the current 'gender blending' that we have to fit into unit cohesiveness. When we had racial integration there was male bonding and a common goal. Is integration of females a major

problem to be dealt with or is it just something that will work itself out?"

Dr. Jones responded by asking, "If I were to tell you the right answer, how would you recognize it?" He elaborated by stating, "That is a politically loaded question which can only be responded to if one knows what the standards are by which you intend to judge my answer. What criteria will you use to say whether my answer is the right answer or not? If we can agree on what those criteria are, I think the answer will come forth pretty quickly." Jones continued, "My personal observation is that there is not a female problem, it's a male problem. If you introduce a woman into any group of males of any age over the age of sexual awareness, their behavior will change to some extent. Some will change in one way and some will change in another. So I maintain that putting women in a formerly all male organization of any type changes that organization. I think it's up to you who have to deal with this on an everyday basis to decide what the nature of those changes are and whether they are changes that you want or not, and you make your decisions based on that. I think putting women into combat units is going to change those units. My instinct is that the change won't necessarily be to make them better than they were before. My feeling is that people hope they will be as good as they were before, but there is some doubt that they will be quite as good as they were before because of the way the men behave, not because of the way the women behave."

Opportunities in Psychology and Physiology

Prospects for Sustaining Human Performance in Army After Next Operations

Doctor (Colonel) Gregory Belenky, from the Walter Reed Army Institute of Research, whose basic and applied research includes sleep deprivation and continuous operations, combat stress reactions and post-traumatic stress disorder, and the neurobiology of human behavior and adaptation, discussed ongoing approaches to studying continuous operations in high stress environments, "a warfighter biomedical status assessment."

Dr. Belenky talked about the Medical Research and Materiel Command's (MRMC) soldier computer and their notional idea of what AAN operations will be like as it supports the capability to assess human performance (physiological, psychological and psycho-social) and stress in real time and use this for operational planning, for casualty prevention and for discreet specific interventions.

Within this context Belenky listed manifold factors that affect resiliency and effectiveness in combat, such as battle intensity, type, and surprise and shock as factors having great impact. He suggested also that organizational factors, such as morale, leadership, cohesion, ethical factors, personnel stability, training and fitness, and prior combat experience, will have high impact.

Clearly, physiological factors contribute. Dr. Belenky said, "Load weight has been well studied. And we now understand that hydration rather than going without water is important. And we are getting to that understanding with sleep. Currently, sleep discipline means doing without, but the gradual perception is dawning that leaders should push sleep the way they push fluids. Both are physiological needs and there is risk when one goes without."

As a component of bio-medical status assessment, MRMC is developing a means to measure sleep under operational conditions. It involves a mathematical model which predicts performance on the basis of sleep measured coupled with on-line, real time, monitoring of alertness and performance, all of which is integrated into hardware and software.

The basic idea according to Belenky "is that alertness in any given human population is distributed along some sort of normal curve. At some point on the tail, one is at risk of making some sort of mistake. By monitoring people's sleep in real time and comparing how much sleep they've gotten with how much sleep they should get we can move the mean on the curve and pull the tail out of trouble. With on-line real time monitoring of alertness we can then actually warn people when they are about to make a mistake and flip the remaining tail into the safe zone and, consequently, keep people out of trouble."

The device currently deployed is a small wrist activity monitor, a self-contained device with a CPU, RAM and an accelerometer which measures and records movements. A sleep scoring algorithm is built in and, from arm movements, records whether the soldier is awake or asleep. There is also a sleep performance model which tells how much sleep one has had in the last 24 hours or the 24 hours before that; it will actually go back 10 days of time. It displays how topped off one is as a percent of 100.

Another component of bio-medical status assessment includes unit and psycho-social measures. Belenky noted that, "though seemly difficult to measure in real time in the same way we are proposing to measure sleep and performance, it really is not. We use surveys and questionnaires that measure well-being using the General Symptom Index of morale, leadership, and cohesion which are based on scales developed from studies starting with the cohort units. These can and already have been administered, during and after a variety of deployments. We are currently scoring the questionnaires in theater and feeding them back, fully analyzed, within 24 hours of completing data collection. By building these questionnaires into the soldier's computer in a helmet mounted display, which the soldier will have anyway, you can basically have these surveys on demand."

Using the Haiti deployment to demonstrate the technique for actually assessing unit climate issues, Belenky recalled that, "In Haiti in the first couple of months in deployment, there were 3 suicides in theater.

So, one of our human dimensions teams went to Haiti and surveyed something like 3,000 out of 8,000 soldiers there. The theater commander had one question, given that he had these 3 suicides; 'Did he have a theater that was in trouble, was it units that were in trouble, or was it simply, tragically but simply, troubled individuals?' The team surveyed 58 units. We used a technique of putting all the individual data into a big bin and created virtual companies by sampling without replacement. We do that a thousand times and generate what would be the distribution of companies if there were no unit factors at work. These artificial companies are then randomly generated. What we found in Haiti is that over half the companies showed lower distress than you'd expect by chance, indicating good unit climate. The others were about what you would expect and three of the companies were outside the norm in the negative direction. They were showing greater distress and two of the suicides had come from one of these companies. Of course this was after the suicides had taken place so we don't know cause and effect, but you can see the obvious suggestion that these three companies might be worthwhile targets for command or targeted combat stress control team interventions."

The real significance of this according to Belenky is that "we are getting to the point where you can do more than just count those who come into the clinic or count what sort of complaints are being made. We can actually go into units and survey them in terms of organizational climate and do it in near real time."

In conclusion, Belenky postulated that "AAN operations will threaten to exceed human mental capability. They are in my view, the mental equivalent or the cognitive equivalent of a 'forced march.' But, through two of the warfighter bio-medical assessments touched on here - direct measurement of sleep to predict performance and the management of sleep to sustain performance over weeks and months and looking at unit and psycho-social issues in terms of their effects, qualitatively, in sustaining soldiers across repeated deployments - we believe that we are developing the sort of systems which will provide tools for operational planning and targeted medical intervention."

Brain Imaging Measures of Cognitive Workload

Dr. Marcel Just, the D.O. Hebb Professor of Psychology at Carnegie Mellon University has pioneered the use of new methods for tracing cognitive processes including eye tracking, pupillometry, and, more recently, neuro-imaging and related detailed performance assessments using computational modeling. Dr. Just is author of major theoretical and empirical publications on reasoning, cognitive modeling, language processing, visuo-spatial reasoning, individual differences, and neuro-imaging.

Dr. Just opened with, "I have had a chance over the past three years to have a brief glimpse into the future. I've been doing cognitive research for decades now. I see in this new technology of brain imaging, fMRI, a lifting of the black box over human intellectual functioning. We are only at the beginnings; we are developing the analytic techniques, the scientific techniques, the paradigms to use it. Today we can show, not just which part of the brain lights up, but how it works as it performs cognitive function."

Just suggests particular interest in relating not only what the brain is doing, but relating it to the intellectual functions, that is to planning, to reasoning, and to decision making. "So, we are interested in studying the dynamics of the brain, relating it to the dynamics of cognition and folding it into the dynamics of situations in which real thought occurs. We are working towards dynamic decision making."

Just described the project as "starting smaller than that, with the comprehension of some complex language and with some visual problem solving. But we are working our way up to an Uninhabited Air Vehicle simulated environment where there are multiple tasks imposed simultaneously, having a spatial component and a decision making component. The properties of these AAN tasks include complex decisions based on multiple attributes of a changing situation,

some degree of information search to retrieve or determine some of the attributes, possible temporal overlap between different tasks and decisions and between the information inflow and the search associated with each decision. Of the synthetic task environments that DoD is researching, we think this captures some of the key attributes and we think we can study it with fMRI."

As an enumeration of implications for the future, Just said, "these techniques can be used for assessing individual differences and focusing on the dynamic aspects of performance, not just static skill assessment. It can be determined who is going to be able to make good decisions under these demanding computational conditions. This assessment can be used for personnel selection, but more importantly for selection of instruction of the interfaces. The new factors that are emerging in task performance are the high information flow which will place tremendous demands on the soldier/operator. By making a huge amount of information available simultaneously and placing tremendous demands on the operators and the decision makers, it becomes the forced march that Dr. Belenky referred to."

At this point Dr. Just described, in considerable scientific detail, studies which allowed differentiating between "thinking harder" and relaxed cognitive thinking.

A major finding showed that, in addition to showing location of brain activity, degree of activation could be measured. This led Just to the conclusion that when harder thinking is required there is dynamic recruitment of other parts of the brain, co-modulation, which means that the cognitive system configures its neuro-underpinnings dynamically as needed.

Dr. Just went on to describe an fMRI view of brain activity which contrasted reading activity with listening to such a degree that he stated, "You show me brain image and I can tell you what the person is doing."

In addition to the new insight about the dynamics of the cognitive system, these findings help explain what he referred to as "decomposition of the cognitive system," *i.e.* recognition that if the brain is looked at as having levels, the first level consists of language or sequential processing system, visuo-spatial processing system, and executive processing system. Further, each level can be further divided as can each level after it. He noted also, "the similarity across systems and across levels and the terrific degree of coordination effected, such that it's almost always a mistake to ask which part of the cognitive system is doing the work. With any kind of task, there are almost always several components doing the work. An organization springs to life and does it and the job of the cognitive psychologist is to find out how that organization works together, what it's composed of, what each part does."

Just elaborated, "to make our theories sharp, to make clear what predictions we are making, what mechanisms we are postulating, we develop computational models that perform the tasks that I am describing to you - models that understand sentences, models that can perform IQ tests, models that can do visual problem-solving. These models not only perform the task, but they perform them like humans. They score similarly to humans. They make human kinds of errors. They take the same amount of time. The modeling system we've been using incorporates all of these insights from the cognitive neuro-science, that has the kind of system decomposition we are seeing in the brain and has that kind of coordination among system components. It's a rule governed sequential at the higher levels, but there are lots of connections like activity parallelism at the lowest levels."

To clarify, Just described "An experiment involving multiple tasks on the subject which had an interesting result. With language alone you see language activation. With spatial alone you see spatial activation. Add them together and you get both which is not so surprising. But there is an interesting additional result. In the single task language, in people who are just processing auditory sentences, you get mostly

activation in the temporal area, the language area, a little bit in the geometric processor. When you ask them to do mental rotation, you get a lot of activation in the parietal area, a little bit in the language area. When you ask them to do the two things simultaneously you get what looks like under-additivity, that is, there is a ceiling on the total amount of activation that you can get out of a person. The error rates go from 12 and 7 percent errors up to 27% when they are performing together. So, there may be a limit to what the brain can do and what humans can do when given multiple tasks to perform."

Just concluded, "I think that in coming to understand the organization of the cognitive system we can understand what its limits are and what kinds of tasks it can be adapted to. As we think about the AAN, the university after next, and the hospital after next, and in fact the society after next, we peer ahead and try to see the landscape. But, first, it's not a static landscape. It's a very dynamic one. Secondly, we are part of the design process of that landscape. We can reject elements or accept them by buying something or being willing to use it or not. So, we have an influence of how that landscape takes shape. While the physiology of man has not changed over thousands of years, the intellectual processes that man has mastered over the millennia have changed. There weren't writing systems 20,000 years ago, and there are now. The genius of human intellect is boot-strapping in many ways. Boot-strapping from culturally acquired analytic tools, such as mathematics and boot-strapping from our own cognitive abilities. The reason that we can do these wonderful tasks now, such as teenagers being able to configure operating systems, is not because there is some biological god-given ability to do this. It's because of the ability to learn, to chunk, to combine information that has been presented by others, to let the parts of the cognitive system work together on new problems, and to dynamically configure themselves to do things that they've never done before. So the way the neurons work in some ways is tens of thousands of years old, but what they do now is different and what they will be doing in 2025 is different. I think we have the means of seeing what their potential is and guiding the landscape to maximize that potential."

Questions & Answers

A questioner from the floor asked Dr. Just about plans to systematically drive subjects past their cognitive limits and see what kind of traces show up in the imagery. "That would seem to be the bottom line for telling the airplane display system when it needs to simplify and adjust to the pilots limits," he noted.

In response Just noted that, "The initial fMRI studies have excluded people who can't perform the task behaviorally. The interesting question you are approaching is 'What is the nature of the breakdown in the brain activity as you overload the system?' We haven't done it. It is expensive to do these studies so we have to prioritize. An example from other's research however suggests that when you give a set of 'not that difficult' problems relating to memory retrieval to Alzheimer patients, but problems that are too difficult for them, you get activation not only in the areas that are active in the control patient, but of additional areas, or a recruitment of secondary areas. It's still not breakdown, but it's on the way. When the system is stressed, it goes out and gets help but does not totally breakdown."

Another questioner from the floor asked Dr. Just if "you will soon have a system that can reliably predict whether or not an individual can handle cognitive complexity under stress to the level necessary for a typical military operation and, if that should come about, do you think this would be a politically, legally, and morally acceptable screening tool?"

Just said "It will be no worse politically than today's intelligence tests. There has been some research on predicting the ability of people who might become 911 operators or air traffic controllers. If you design a laboratory test that has some of the characteristics I mentioned, there is a correlation of something like sixty per cent with on the job performance rating. So, you don't even have to do fMRI for that, but

if you want to get into more detail than, for instance, whether demand is spatial or visual, a planning demand or a verbal demand, fMRI will allow us to conclude that this person can perform the task so long as he doesn't have to do too much geometric computation *etc.*"

Dr. Jones then asked Dr. Belenky if there is "any feel for the subject of emotional activation and sleep deprivation? Did you see, in any of your experiments, any increased emotionality or any increased susceptibility to emotional trauma and fatigue?"

Dr. Belenky noted "Ours is a safe setting because we are running human subjects. We have two staff people for every subject so it's not very demanding. What we see is, with an increase in fatigue, a decrease in subjective alertness, increase in subjective sleepiness, increase in subjective effort. But the other emotions like anger, hostility, fear -- these things are not consistently affected. I suspect they would be under true operational circumstances but what we see is basically what you'd expect, an increase in sleepiness, an increase in effort and a decrease in energy."

Opportunities in Psychology and Physiology II

Dr. Jagdish Chandra of the U.S. Army Research Laboratory introduced the second panel on Opportunities in Psychology and Physiology, noting that General Ulmer had earlier pointed out "that when we talk about AAN, very little attention is paid to the human factor. I think we have now turned the corner to talks which address some of those issues. In this panel we will be addressing the human factor from the points of view of computer sciences and information sciences. That is an aspect of information which I think is very critical and needs to be addressed. The idea here is that the computer systems and related software are to handle the issues that come about in terms of expanding battlespace, increased amount of data, information overload, *etc.* so that the commanders can concentrate on the art of war, developing mental models and cognitive models of war. That is the basic concept of information sciences that we will address."

Applications of Haptic Interfaces

Dr. John M. Hollerbach, Professor of Computer Science and Research Professor of Bioengineering and of Mechanical Engineering at the University of Utah, introduced some of the many mechanical interfaces available for virtual environments. He detailed the positive and negative aspects of several devices included in the categories of position trackers, haptic interfaces and locomotion interfaces.

Dr. Hollerbach followed the introduction of the different classes of devices with a discussion of applications, particularly of haptic interfaces. He noted that "we are very interested in manufacturing applications, namely virtual prototyping, especially in the context of computer assisted design (CAD) systems. The idea is that not only will you design something, you will be able to physically interact with your design before building it. You will be able to grab an object, feel it and get a realistic mass. You will be able to have realistic geometrical interaction. You can check for interference, collision, and paths of assembly."

Hollerbach also indicated an interest in the question of ergonomics. In addition to the kinematic manipulations, they would like to add the sense of force. One would be able to take a mechanism and move it around to experience realistic inertial forces. When a person is doing

something, what forces does that person experience? Is that person going to hurt a joint by doing that too often? Is this a bad way to reach? "We'd like to quantify not just the kinematic, but the forces which are exercised in a variety of situations. You might say that adding a haptic interface to the CAD system is a way of increasing information visualization, which is a broader category. But I'd like to think even more broadly of perceptualization - somehow using our senses such as touch and sound to understand information better."

Dr. Hollerbach said, "We are also doing some work in visualizing computational programming. A Department of Energy project to replace nuclear testing with simulations is ongoing where we are interested in the storage of nuclear devices. We are worried about what happens to devices in accidental fire or explosion situations. The sponsors are worried about what you do with all this data you get from simulation. How do you understand it, how do you comprehend it? How do you manipulate it? Vision is one aspect, but we are also adding haptics to computational dynamics. We are also using haptics to probe medical images. Other people have done molecular docking, which might be used for drug design. Finally, the issue of training, especially in terms of locomotive interfaces and surgical simulators, is being examined."

Dr. Hollerbach, with the assistance of video tapes, described a number of other potential applications that are being worked on, including modeling and manipulating the interaction with nerve representation, scientific visualization of computational fluid dynamics, and medical imaging. Dr. Hollerback is enthusiastic about the future of simulations and virtual environments using mechanical interfaces, particularly haptic interfaces.

Designing Real-Time Virtual Humans for Military Applications

Dr. Norman I. Badler is a Professor of Computer and Information Science at the University of Pennsylvania. He addressed work done at the University of Southern California Information Sciences Institute concerning unmanned fixed wing aircraft.

Dr. Badler described a program which included a total of 722 UMV flights over a forty-eight hour period. Three air-tasking orders were flown; one for twelve, one twenty-four, and another for twelve hours. The flights were actually integrated into the Air Force and Navy operational environment. Badler said, "The services generated their air tasking orders through multiple layers of software which, with a little bit of human intervention, went to our automated pilots; they then flew the missions. While these automated pilots were flying their missions, there was no human overlooking them saying 'Turn left here or go engage there.' The only interactions were via simulated radios, which ended up being messages on the network. Our planes accepted them and then proceeded to execute the appropriate behavior. During one massive strike, we had over one hundred UMV in the air at once. Using verbal commands, we had control of these planes in tactically and doctrinally correct ways. This was possible by use of a program that allowed speech to text and text to speech generation; so, we had a human sitting at a microphone acting as an AWACS controller giving 'bogey' information to our planes, directing them to change reference points and things like that."

Badler then reflected, "The conclusion is not that we can do all this, but it does demonstrate that it's possible to do this and that maybe we can get all the way there in the future. The reason we can use language now, and that its use is not something ten years away, is because there is a very constrained set of interactions between pilots and between controllers and pilots. So, when our planes are flying, they are actually sending messages between themselves, using their radios, that correspond to the messages that humans can use. Our

hope is that very soon we will be able to connect this to human simulators so that humans can fly with these aircraft."

In terms of evaluation, this was considered an unqualified technical success. The reason it is an unqualified technical success is because it was not an operational success. This program was intended to be integrated with Operation United Endeavor to provide training for the higher levels of command in a large battle environment. Unfortunately, this was the first time all the software actually worked in one place so it was not a success from an operational standpoint. With more experience in using this technology it can also be an operational success.

In defining intelligent forces Badler explained "We developed them using an artificial intelligence (AI) rule based architecture based on some fifteen years of research and artificial intelligence and cognitive modeling. It's been used for many different applications in artificial intelligence and it's actually been used for modeling low level human behavior at the level of fifty milliseconds and above. Within the context of this application, we also embedded it with another software that provided the simulation of sensors. We had very realistic radar sensors and weapon systems. We had realistic air to air and air to ground weapons and vehicle dynamics. When they flew these missions, they were completely autonomous. However, these systems have to be developed by hand. It took us approximately 12-13 man years to develop this piece of software. However, it does obey doctrine and employs tactics as appropriate and it can perform all the aspects of a mission. It does take the initiative as is needed. For example, during one of our close air support missions some F-18's happened to have air to air missiles as well as air to ground ordinance. They encountered RED forces along the way. They temporarily gave up their close air support mission, intercepted the air to air threat, downed it, and went back to their close air support mission. They are able to mix goals and were not just preprogrammed, an important point. These are not scripted as to exactly what they are supposed to do. Instead, we program the doctrine and tactics that human pilots

would use. They use the same information as would be used by pilots from a briefing of the air-tasking order."

The basic architecture is rule based architecture on distributed, up to thirty, computers with each computer having four to six planes running at one time. Badler mused, "I would love to say that we have had it validated and that it corresponds to exactly what Air Force and Navy pilots do in these situations. I can say that one time when somebody in Washington was watching the behavior of some helicopters, which we were generating on the other side of the country, the person swore a person was flying the helicopter when it was actually controlled by automated pilots. However, when our experts looked closely at the behavior they said, 'Not a bad Third World Country.' That is not too bad, but clearly not at the level of US pilots. One of the real challenges is to be able to write a system that is efficient enough so that you can run a real time simulation where, as your plane is flying along at 500 knots, you have to have decisions made because it's not possible to just stop the simulation and have the thing think a little bit longer. It has to continually be making decisions."

In talking to the future, Badler said, "We hope to extend this to other applications and have more human like behavior. The work that is being done in the cognitive psychology community can be used to build computational models of these different phenomenon, fatigue for example. Can you model fatigue in these simulated pilots? As it stands now, our simulated pilots would land and be sent right back up the next minute; they would fly missions every hour of the day. That is not realistic, as we know reactions change over time. We want to get that embedded into our model. We also want to make them more human in terms of human emotion, training *etc.* It is clearly a 25, 30, or 50 year project to get all those kinds of human like behaviors. Additionally, we are trying to work on more automated knowledge acquisition. To build these systems requires a lot of human time so we are looking at how to have the systems learn automatically by observing people performing the same tasks. This would involve

instrumenting people while they are flying planes, talking about what they are doing and trying to extract from them the knowledge they used in flying those missions."

As to where artificial intelligence forces will be in thirty years, Badler said "we will be able to have detailed simulations, in real time, of complex human behavior. We will be able to have average behaviors of groups of people and we will be able to simulate specific individuals that we have monitored. We can give the standard reaction times and error rates that real people would give in similar situations. I think we will also be able to create simulations that are sensitive to many environmental, physiological, and psychological forces."

Badler also feels that it can be done across the services. It has been done first for the Air Force but many of these techniques will apply to all the other services. The most difficult to simulate will be individual combatants because they have to have close and flexible interaction with the terrain and with the physical world. The aircraft provides a nice interface to the outside world where there is no requirement to model at the low level of human physical interfaces. It is also going to be difficult, according to Badler, to extract and build computational models of high-level command because there is such a lack of doctrine.

Badler closed by noting, "Once we do have these models we can have much more realistic training at all levels of the command hierarchy because we will be able to inject people into realistic situations wherein they will be able to train, not just against an environment, but against an opponent that has much the same capability as do they."

Vulnerabilities in High Tech Warfare: Addressing the Challenges

Intelligent Automated Support Systems

Dr. John Leddo, Research Development Corporation, has extensive experience in education, training, experimental psychology, cognitive science, and Artificial Intelligence research and development. Dr. Leddo is currently managing a project sponsored by the National Institutes of Health to develop knowledge elicitation tools for education. *No audio recording is available of the presentation by Dr. Leddo from which to produce a brief for these Proceedings. The paper on which Dr. Leddo's presentation was based follows except for the omission of certain headings and figures.*

Unfortunately, the same problem confronts Intelligent Automated Support Systems (IASS) that confronts other artificial intelligence (AI)-based systems. AI systems are known to work well for highly constrained problem sets but tend to "break" when pushed beyond their programmed limitations. As the battlefield and Army systems continue to grow increasingly complex in the 21st century, IASS will have to grow beyond this limitation in order for them to have continued benefit to the Army. The goal of our research, which is reported in this paper, is to develop IASS that are more robust to diverse problems and are scaleable to meet new challenges posed by rapidly evolving problem domains.

We begin our discussion of our approach to developing IASS by noting that an intelligent automated support system has two primary components: a knowledge base and a reasoner that uses the knowledge base to solve problems. Therefore, the quality of an IASS is tied to the quality of these components. The limitations of the IASS cited above can be traced to limitations in the knowledge base or the reasoner. For example, knowledge bases are often constructed specifically for a set of predetermined problems. As a result, the IASS is very efficient at handling problems for which it was constructed, but breaks quickly when presented with problems that lie outside this predetermined problem set. Similarly, the AI reasoner built into the IASS often employs limited reasoning heuristics such as rule-based

problem solving or decision analytic techniques. Again, the systems are effective when confronted with problems for which these reasoning approaches are appropriate, but fail when problems are encountered that require different reasoning approaches.

People, on the other hand, typically do not have these limitations. First, their knowledge is more generic. In other words, they are domain experts, not experts on individual problems. Second, they have diverse reasoning styles that can be used for different problems.

Our goal is to develop IASS that emulate these human problem solving qualities. Therefore, we have focused on knowledge representation and reasoning techniques that support more generic and diverse knowledge types than are typically found in IASS. We couple this with a modular computer software architecture to allow for software reuse and modification. This affords both cost reduction across projects and scaleability to expand the technology as the users' needs also expand.

We have demonstrated this technology by working with the Infantry at Fort Benning to develop training and mission planning and rehearsal technology for the dismounted infantry task of military operations in urban terrain (MOUT). The IASS emphasis has been squad and fire team level building clearing operations. Our objectives have been to develop technology that can support training, mission planning and rehearsal and to demonstrate the robustness and scaleability of the technology.

In order to make the technology robust and scaleable we wanted a modular technology that was independent of any delivery system. Therefore, the main components of our IASS technology were the expert system, made up of knowledge model and reasoner, a simulator which could be substituted for another delivery device, and middleware to communicate between expert system and simulator, thereby supporting substitution of the simulator with other delivery devices.

In order to make the expert system behave as closely as possible to human problem solving behavior, extensive knowledge engineering was conducted with subject matter experts supplied by Fort Benning. This was supplemented by observing live training exercises at the MOUT Site at Fort Benning, conducting role playing exercises and by reading published doctrine.

In order to accommodate the richness of the problem solving skills observed in the experts, two innovations were made to the typical expert system technology found in many IASS. To handle the MOUT problem solving domain and allow more open-ended behaviors, a richer knowledge representation framework than is typically found in many production rule-based expert systems was used. This knowledge model framework was based on previous empirical research on how experts solve problems.

This research shows that experts use a variety of problem solving approaches that are richer than a simple production rule or other single formalism process. As a result, an Integrated Knowledge Structure (INKS) framework was created that blends scripts, production rules, semantic knowledge and mental models into a single formalism. INKS allows an expert model to process known problem solving sequences as a production rule system would, but also allows a system to use mental model to reason from first principles given the semantic information available in a situation.

For example, when a fire team moves down a hallway and approaches a door, there is a fairly routinized procedure for stacking, breaching the door and entering the room. In cases where multiple doors are present a decision must be made as to which room to clear first. In such cases, at least two decision-making processes are possible. The first is to "hardcode" every possible permutation of how many doors there are, whether they are marked or unmarked (indicating that they are already cleared) and whether the doors are open or unopened (indicating a potential threat as an open door constitutes a potential line of fire from enemies within the room). The expert system could

literally evaluate each of the antecedent conditions to determine which rule to fire and in doing so, which room to clear.

An alternative approach, which the INKS expert model allows, is to reason from first principles. To accomplish this, the INKS knows about the goal of preserving the safety of the fire team. It knows that being in an enemy line of fire constitutes a safety threat. Therefore, when confronted with multiple rooms, the INKS can evaluate each room to determine which constitutes the greatest safety threat and then decide to clear that one first. By using this mental model approach to evaluating safety threats, the system is not required to have a preset rule to assess a trainee's decision, but can still make the assessment based on known goals and situational (semantic) features.

Being able to reason from first principles leads into the second objective discussed, namely creating an IASS that is generic. Having mental models that reason from first principles is a step in the right direction as this supports reasoning about general cases rather than hardcoded examples.

This train of thought was continued by building the INKS to be a generalized MOUT expert rather than one that was knowledgeable about the specific simulator, floor plan or scenarios used. This was accomplished by encoding the domain knowledge in generic terms such as moving down types of hallways rather than specific hallways, entering types of rooms rather than specific rooms, etc. By doing so, the system is able to reason about any scenario as long as it can make the determination about what type of situation it is in. This makes the IASS independent of the simulator. Because of this, we created middleware to act as method of communicating between the two.

The middleware takes information from the simulator and passes it to the expert system in real time. It converts simulator information into a form that the expert system INKS can understand. As such, this means that as long as a communications protocol can be

developed, the expert system can link to virtually any delivery device (we discuss some examples of this shortly). The IASS runs on a standard Pentium PC.

One of our project goals was to extend this core technology to support team use. This was done in phases. First we built a single station for a fire team leader. Then we extended this to include a networked station for the squad leader.

However, the goal was more than to simply build a second IASS. The goal was to create a team trainer, mission planning and rehearsal system. Here, the challenges of creating a distributed problem solving environment while still preserving individualized support needed to be addressed. There was an additional technical challenge. The project goal was to create IASS for a squad leader and a fire team leader working together. However, a squad has two fire teams. Therefore, in order to preserve the realism of a two fire team squad, intelligent agent technology was used to play the role of the second fire team (this technology is discussed shortly).

Fortunately, the basic IASS architecture supported these extensions. First, the MOUT simulator was reused for the squad leader IASS. In order to give the squad leader a separate perspective corresponding to what he would see, a duplicate simulator but with a camera (viewpoint) corresponding to what he would see was created. The squad leader was also provided with a sky view so that he can still watch the actions of the fire team after they disappear into a room.

The next step was to build the appropriate expert system for the squad leader. The key step was to build the squad leader expert model. This was done in the same format as the fire team INKS. Because INKS is a canonical structure, the same AI reasoner was reused. Once the simulator with the squad leader perspective and the squad leader ITS were created, middleware was constructed to link the two as was done in the fire team leader trainer. This middleware was essentially the same as for the fire team leader. The semantic overlay of the

floor plan was identical. The main difference was to be able to pass the squad leader commands in the simulator to the squad leader IASS.

The technology, as described above, constitutes two separate IASS. However, the goal was to develop a team environment, so the two systems had to be linked. The linkage was provided through the middleware. Here, in each system, the middleware passed each user's simulator commands not only to his own expert system but also to the other user's middleware. The other middleware then updated the second simulator so that the user would view the same events as his partner. To synchronize the two simulators, an internal simulation clock was created. Each event that was passed between the two middlewares was time-stamped so that the receiving middleware could update its simulator in a way that would preserve the synchronization between the simulators. The synchronization between simulators is a standard DIS problem and the present paper does not claim to have made any innovation in this area.

There is one final issue. The present technology is comprised of one squad leader system and one fire team leader system. However, a full squad has two fire teams. The second fire team was "played" by an intelligent agent.

One of the features of the present IASS technology is the expert problem solving model. This expert problem solving model evaluates the user by computing its own solution to the problem and evaluating the user against that solution. This feature of the expert model was used in order to create an intelligent agent that would do the same.

Therefore, when the squad leader issued a command that would ordinarily be carried out by the second fire team (fire team B), the expert model would generate an expected action on the part of that fire team. These commands were then automatically carried out. This enabled the agent for fire team B to respond to squad leader commands.

There were cases where the fire team leader would normally issue his own commands. In this case, the expert model would be receiving information, via the middleware, of what events were happening in the simulation. The expert model then computes what the fire team leader should command. In this case, rather than waiting for the user to issue a command, the expert model simply issues the command itself.

This ability for the expert model to operate either in training mode (when a real trainee is issuing commands) or in agent mode (to issue a command itself) created a unique feature of the technology. Specifically, the team IASS could not only support two person use, but also a single person in either a fire team or squad leader role. This was accomplished by having a toggle that transferred control of the fire team leader or squad leader from human to computer and back again. This principal was extended further by allowing the computer to play both roles. In this mode, the IASS operated as a mission planning and rehearsal system.

A principal goal of the present project was to create a generic IASS architecture that could be a model for rapid technology construction and software reuse. There were four dimensions along which we were interested in demonstrating the robustness of the technology. These were:

Scaleability
Technology reuse
Robustness to problems
Realism

The scaleability of the technology was demonstrated when we extended the technology from a single person fire team system to a squad and fire team distributed team IASS.

We had several opportunities to demonstrate technology reuse. Part of this also came in the development of the team IASS development

as we reused the single user IASS simulator, middleware and AI reasoner to construct the team IASS.

We had other opportunities to reuse the IASS technology components. These included reusing the expert system in two other delivery devices: a two dimensional simulator constructed by RDC and an immersive virtual reality simulator constructed by an independent contractor. Additionally, we received a contract to develop medical assessment software. Here, we developed a new simulator, middleware and INKS, but were able to reuse the AI reasoner. The latter demonstrates the robustness of the technological approach and component technology even for a totally unrelated application.

The third robustness criterion relates to the diversity of problems the IASS can support. In order to address this issue, a scenario editor was created that allowed a user to enter his own scenarios by manipulating certain parameters (e.g., number and location of enemies, their level of training and whether they were combatants, number and location of civilians). As stated earlier, the present technology allows the computer to run the role of the fire team leader or the squad leader because it processed scenario information in real time and made its own decisions regarding what actions to take.

In this case, numerous demonstrations of our technology were given. Each time, observers were allowed to create their own scenarios and have the expert model run the simulation. There were no cases where the scenario created by an observer "broke" the system or created an unexpected event.

The fourth and final criterion was realism. Are the solutions to the problems developed by the IASS realistic or artificial? One way to demonstrate this is to compare IASS solutions to those of a knowledgeable human. To effect this, a single problem scenario was created using the scenario editor. We recorded a human, knowledgeable about MOUT, solving the problem and the IASS solving it. The solutions were played side by side to seven groups of

observers. Groups ranged in size from two to twelve people. Four of the groups were comprised of military experts who presumably knew the expected behavior of a MOUT expert. Three of the groups were comprised of engineers who presumably understand the behaviors of expert systems. Observers were asked to say which solution was given by the IASS and which by the human. Approximately 90% of the observers stated that they could not tell, while the remaining were just as likely to guess incorrectly as correctly.

Coping with: Information Volume, Complexity and Intelligent Automated Support Systems

William B. Cunningham, P.E., from U.S. Training and Doctrine Command, followed Dr. Leddo's discussion noting that "part of the problem is coping with the kinds of automated support that 'we engineers' love to build." *Regrettably, no audio recording of the presentation by Mr. Cunningham is available from which to produce a brief for these Proceedings. The following short excerpt is based solely on the PowerPoint slides used for his presentation.*

Determining how to generate, transport and process only relevant data is a necessary part of the solution, simplifying the huge organizational effort that tends to overload recipients with more data than is necessary for adequate information. Since relevance is both situation dependent and idiosyncratic, information is required to establish context for interpreting subsequent information. For a busy person juggling many tasks, relevance applies to the task of the moment and to the supervisory function of when to change tasks, which in turn changes what is relevant.

Cunningham went on to posit that relevance has to do with control, and in any common control model two things are important to the decision component. First he said "Battlefield visualization is filtered out. The decision authority's world model is the filter which determines relevance. If a world model becomes invalid, the system

response will be inappropriate." The second significant aspect of the decision component is that "the central control system resorts to time sharing in which a filter is actually a composite of multiple filters. But because the real world is an open nonstationary system for which the world model and filter must adapt, alerting for selecting and shifting control, based on pattern matching or variables exceeding thresholds, may not be possible in advance."

The definition of types of crises in terms of potential control failure was acknowledged by Cunningham to be somewhat arbitrary, but "instructive" he felt. He cited four crisis models for which automated support systems solutions are required. The disambiguate with known patterns represents an information starved problem where relevant information must resolve the ambiguity. The unstable or invalid patterns represent the open nonstationary real world in which the world model is demonstrated to have failed and that it must be fixed or replaced. Information overload clearly is finding relevance in the 'firehose' and the beyond control model simply means that additional time and resources should not be wasted trying to control a situation not controllable.

Cunningham then described "promising approaches to dealing with this problem." The detailed descriptions are omitted here but generally he mentioned a Russian group, who have long viewed control as a second order system that includes both command and control and who aimed at constructing a new model from fragmentary information developed iteratively with a human expert in the loop, called Quasi Axiomatic Theory. Cunningham said "The Russians are addressing a difficult problem yet to be addressed by the West. Their methodology appears to be a codification of human processes for abductive reasoning." He also talked about "a goal seeking cognitive model with specific problem solving templates similar to the Russian's." This involves decomposing and reassembling information at multiple resolution levels, providing clues for machine assistance, but no formal logic operations. He also described a cognitive model to accommodate open and nonstationary situations with a different

scheme for decomposition and reassembly called the Virtual Network Framework and a fourth new and altogether different approach applying sensitive physical models to real worlds situations. This physical modeling of unstable phenomena runs very rapidly and requires little information to produce tentative conclusions.

In conclusion, Cunningham said "it is really important to recognize that it is fundamentally easier to generate data than to dispose of it intelligently." Information sources will always outpace processing technology. He also suggested, "We really do need to go through the scientific process to learn how humans process information to achieve understanding and how large epistemic systems should function. This is a huge engineering problem. We can all help by demanding an understanding of the infotheoretic processes rather than products that implement our current level of understanding. Armed with better understanding and better tools we should expect to see changes in individual and organizational processes. The Army is, after all, an epistemic system!"

Information Management Performance and Errors Under High Information Load

No audio recording of the presentation by Dr. Elliot Entin, a Senior Psychologist in the Information and Decision Systems Division of ALPHATECH, Inc. is available. *The paper, co-authored by Entin, Caroline Kerrigan and Daniel Serfaty and on which Dr. Entin's presentation was based, follows except for the omission of certain headings and figures.*

Military officers performed situation assessment tasks under moderate and high information load conditions and with either shallow or deep knowledge of the organization. Results clearly indicate that high information load negatively impacted performance as hypothesized. Although weaker, there was evidence that deep organizational knowledge facilitated performance under moderate and, somewhat,

under high information load. Participants committed many errors identifying critical messages and sending messages to appropriate nodes in the organization. Some errors were exacerbated by high information load.

The recently published vision of the Chairman, Joint Chiefs of Staff for warfare in the information age, Warfighting Vision, 2010, stresses the importance and the potential problems of the information management and the inter-connectivity implied by information dominance concepts. Enhanced C4I systems must "handle all the data provided by the expansion of sensors, access and sort the important data, and transfer, to the weapons and forces best suited for the engagement, the information needed to successfully engage these targets. This process involves nodal analysis at the strategic, operational, and tactical level, and *could well be an Achilles heel*" (Warfighting Vision, 2010, emphasis added).

DiNardo and Hughes (1995) are more blunt in their assessment of the potential pitfalls of information warfare and the dangers of increased communication and connectivity: "...every improvement in communications has always carried with it the dangers of micromanagement ...Another danger...is data overload....commanders will be so bombarded with a blizzard of largely extraneous or even unessential data that it will obscure the real issues." During the first twenty-four hours of Desert Storm, the Joint Forces Commander received more than 1.3 million messages. It will be essential to reduce this number to a more manageable level in future conflicts, and to ensure that staff and commanders can find the real "nuggets" of information in this flood of data. Salomone and Crecine (1996) emphasize the criticality of organizational issues in an information rich environment, and suggest that "perhaps the greatest 'fog machine' of war ...is the overload of information."

We define information management as the set of cognitive processes and behaviors that include the receiving, integrating, filtering, storing, processing, seeking, and exchanging of information by an individual

decision-maker in an organization. Information management has become increasingly important in domains such as the military which have seen a tremendous influx in technologies that are capable of overwhelming individuals and teams with information. With advances in technological capabilities that make it possible to transmit and access large volumes of information, information management has become more important than ever before. In the military area, 'digitization of the battlefield' will precipitate a *de facto* flattening of the Command and Control (C2) organization in which everyone will have access to more data than ever before. But the availability of larger and larger volumes of information, rather than supporting individuals in the performance of their work, may instead impede them by increasing their workload, bogging them down with unnecessary details, and diverting their attention from critical elements. In order to meet the promises of total battlefield awareness that advances in information distribution make possible, information management skills are critical. It will be necessary to train commanders to manage information effectively in order to gain a coherent picture of the battlefield. Without information management skills they can be so overwhelmed by data transmission that they do not have any cognitive resources left to manage and utilize this information effectively.

In light of the changing battlefield environment, a new training objective must arise -- to train warfighters to better manage information. The goal of this experiment is to empirically identify information management strategies, techniques, and skills that are amenable to enhancement through training with the hopes that it will eventually lead to a training approach for a more effective handling of information on the battlefield.

Sixteen military officers enrolled in command and control classes at the Naval Postgraduate School participated in the experiment. Most participants had a military rank of O-3 or O-4. All services were represented in the participant sample.

Two major independent variables, information load and knowledge of organization structure, were implemented in this experiment. There were two levels of information load: moderate and high. In the moderate information load condition there was a reasonable rate of information flow (approximately 1.3 messages per minute), whereas in the high information load condition the individual was deluged with information (approximately 3.1 messages per minute). Information was conveyed to participants via electronic, hand-carried, and telephone messages, with the largest proportion of the messages being conveyed electronically. There were two levels of organizational knowledge: shallow and deep. To implement shallow knowledge, we provided a one page summary showing a diagram of the organizational structure and a one-line description of each available node. For deep knowledge, we supplemented the diagram with a detailed written description of the roles and functions of each node, and the classes of information possessed and required by each node. We used an unconventional, futuristic organization so the participants could not easily tap into existing knowledge.

Information load was implemented as a within-subjects variable and knowledge of organizational structure as a between-subjects variable. The two independent variables were completely crossed to produce a two-between by two within-subjects design. Participants were randomly assigned to one of the two levels of organizational knowledge. Each participant performed under both moderate and high levels of information load.

The major performance tasks were periodic situation assessment briefings, both oral and written. The experiment trial was divided equally by time into three periods. Each participant gave an oral briefing after each thirteen-minute interval. Participants were told that they would have to give two short briefings after the first and second intervals, and a final briefing, which was more complete, at the end of the trial. At the end of the third time interval, participants also completed a written situation assessment.

All verbal briefings were videotaped. Using the videotaped oral briefings and the associated written materials, a subject matter expert (SME) evaluated the participants on four aspects of their performance: 1) identification of information gaps, 2) information resource management, 3) course of action development, and; 4) overall situation assessment. The first three measures can be viewed as aspects of the fourth scale, the overall assessment of the situation. The performance evaluations were made separately for each time period, using a 7-point graphical scale.

Participants were required to rate all incoming messages that they opened on a zero (irrelevant) to three (highly critical) scale. For analysis purposes, message criticality was collapsed into two categories: noncritical (those rated 0 or 1 by the participant) and critical (those rated 2 or 3 by the participant). Messages not opened by participants were considered as having been implicitly rated as noncritical.

Participants were also permitted to send messages to different nodes in the organizational structure to ask for more information about the situation, or to forward messages they received to a node that they felt was more equipped to handle the information. Two dependent measures were developed for messages sent out by participants. For one measure, an SME categorized the destination address of each message transmitted by the participants into three node levels: 1) subordinate nodes; 2) nodes at the same level as the participant's; and 3) superior nodes. For a second measure, each message was coded by the SME as being sent to the correct or the incorrect node level.

Participants participated individually in the experiment. Each participant participated in two experiment sessions, held approximately two days apart. A map on the table showed the critical area and was updated periodically with clear plastic overlays during each session.

At the beginning of the first session, the experimenter presented an overview of the experiment procedure and purpose, gave a brief overview of the scenario, and answered any questions participants posed about the scenario. Following the scenario review, the experimenter reviewed the organizational structure in which the participant was working.

Each experiment session was scheduled for two hours. The experiment trial, itself, lasted 39 minutes. During the experiment trial, participants had the capability to read, save, delete, list, and send electronic messages. In sending they could either transfer information to team members more equipped to deal with a received message or request information from another team member. All other nodes in the organization were role played by a trained confederate, who responded to participants' mail messages when appropriate.

In the second experimental session, participants received information about the new vignette and then proceeded with the second trial. After completing second trial, participants were debriefed.

We hypothesized that a high level of information load would negatively impact participants' ability to perform a situation assessment task because the high rate of message flow would leave them with insufficient time and cognitive resources to adequately comprehend and interpret the information they received. A three-way analysis of variance (data collection interval is the third factor) shows that participants attained significantly higher scores ($ps < .01$) for each of the four performance items when information load was moderate rather than high. Clearly the hypothesis that high levels of information load would negatively impact participants' ability to perform a situation assessment task is supported. We hypothesized that deep organizational knowledge would enhance performance, especially those aspects associated with resource management and course of action development, by helping them identify appropriate sources for both incoming and outgoing messages. Some evidence of

this is a significant ($p \leq .05$, one-tail) organizational knowledge by information load interaction indicating that whereas performance was flat between shallow and deep organizational knowledge for the high information load condition, participant performed higher in the deep than shallow organizational knowledge condition when information load was moderate. We also hypothesized that deep organizational knowledge would be especially important when information load is high. An indication of this comes from examining situation assessment performance in the high information load condition across the data collection periods. When organizational knowledge is shallow the means for the three data collection periods are about the same. When organizational knowledge is deep the performance means are about the same in periods one and two, but than increase significantly ($p < .05$, one-tail) in time period three. Thus, there is some evidence, albeit weak, that deep organizational knowledge can enhance performance when information load is high. We now turn to analyses of errors made in criticality ratings.

Participants rated each incoming message in terms of its criticality. We hypothesized that participants would have more time to evaluate the messages and therefore be more accurate in identifying the critical messages in the moderate information load condition than in the high information load condition. We also hypothesized that a deeper level of organizational knowledge would facilitate identification of critical messages by consideration of the source of the message. If participants were accurate in discriminating critical from noncritical messages, they would rate as critical 100 percent of the critical message and zero percent of the noncritical messages. Participants were not accurate in discriminating between critical and non-critical messages in either information load condition. Within each information load condition, participants were about equally likely to rate noncritical messages as critical as they were to rate critical messages as noncritical. In the moderate load condition, they rated about 40 percent of the messages as critical. In the high load condition, they rated about 25 percent of the messages as critical. From the point of view of signal detection theory, if these data were

plotted on a receiver-operator characteristic (ROC, Green and Swets, 1974) curve in terms of hit rate (proportion of critical messages correctly identified as critical) and false-alarm rate (proportion of noncritical messages falsely identified as critical), performance would fall along the diagonal (or chance) line in both conditions.

A second important finding is that in both conditions participants overrated the number of critical messages. In the moderate load condition, where the true proportion of critical messages is .20, participants identified almost 40 percent of the messages as critical. In the high load condition, where the true proportion of critical messages is .08, participants called almost 25 percent of the messages critical. In other words, in addition to being unable to discriminate critical from noncritical messages, participants evaluated too much of the information as critical.

In the experiment participants could send messages to any node in the organization. These messages could be sent to transmit relevant information to other nodes in the organization or to seek information from other nodes. We examined the correctness of node destination (i.e., was the message sent to the appropriate node level in the organization). Participants were most accurate in the messages they directed to superiors and least accurate in the messages directed to subordinates ($p<.09$).

We also found that level of information load was related to accuracy of node level, with accuracy being significantly ($p<.01$) higher by about 10 percent in the moderate than in the high information load condition. This finding suggests that when message load is moderate, there is more time to think about the appropriate destination for messages that are transmitted, whereas increasing message load consumes cognitive processing time and energy and reduces the amount of time available to consider who needs what information, with the result that an increased volume of irrelevant information is introduced into the system.

The hypothesis that high information load would detrimentally effect performance was clearly supported. Participants performed at a higher level on all the performance variables when information load was moderate than high. The impact of organizational knowledge on information processing was more subtle. For one of the performance variables there was evidence that deep organization knowledge improved performance, but only when information load was moderate. There was also evidence that deep organizational knowledge improved participants performance somewhat in the high information load condition but only late in the activities. Informal exit interviews conducted shed some light on the weak showing of organizational knowledge. Individuals assigned to the deep condition were given, in addition to the one page organizational chart, a booklet describing in some depth each node of the organization to study several day prior to the experiment. A few of the participants admitted they were pressed for time and only really studied the one page organizational chart. In light of the results and this information we believe organizational knowledge was not adequately tested and merits inclusion in subsequent information management research.

Participants committed a considerable number of errors determining the criticality of message information, regardless of experimental condition. They had a difficult time identifying critical information and rejecting non-important information. Participants also committed a fair number of errors routing messages to the correct nodes in the organization. Collectively, these errors indicate that specific training in these aspects of information management would be quite beneficial. Conditions of information load in the military will only get worse. Good information management skills are imperative.

Public Opinion and Its Implications for the Army After Next

Dr. Patrick O'Heffernan, of the Sam Nunn School of International Affairs at Georgia Tech introduced *Public Opinion and Its Implications for the Army After Next* by noting the opportunity to look at some interesting long term questions about what news organizations have become and what they are doing to the society from which military organizations have to recruit and from which they have to get their support. O'Heffernan said that his editor "once told me that my job was to give people the information they needed to know to make democracy work. The key words in there - information, what people need to know, and democracy - are no longer valid advice. When you talk to the vice president of a large media organization, you are told that your job is to give people the entertainment they want so you can deliver the 'eyeballs' that the advertisers want. It's an entirely different world. That is to say, media organizations now have a different agenda - an agenda that is different from that of the country, from that of military organizations, and from that of democracy. That agenda isn't necessarily bad, it's what makes American media organizations the best in the world and the most profitable in the world. But we do have to remember that the agendas are different. News organizations, even in places like CNN, are almost a dying breed. They're now called media enterprises. The new agendas are having some subtle effects and some not-so-subtle effects. Those effects cut to the heart of the public's attitude toward national security, towards military service, towards the draft, and for those countries in which there is a draft, towards the whole idea of participatory democracy and personal responsibility."

Overcoming the Underdog Syndrome: Paradox and the American Way of War

Dr. Earl Tilford, Director of Research and Senior Research Professor at the U.S. Army War College's Strategic Studies Institute, opened his discussion of the underdog syndrome with a quote from Clausewitz, who defined war as:

> "...an act of force to compel our enemy to do our will. Force, to counter opposing force, equips itself with the inventions of art and science. Attached to force are certain self-imposed, imperceptible limitations, hardly worth mentioning, known as international law and custom, but they scarcely weaken it. Force, that is physical force, for moral force has no existence save as is expressed in the state and the law, is thus the means of war; to impose our will on the enemy is its object. To secure that object we must render the enemy powerless; and that, in theory, is the true aim of warfare."

Two decades ago, Russell F. Widely, in his now classic The American Way of War wrote,

> "Once American military power became great enough to make the destruction of the country's enemy an object worth contemplating, a central theme of the history of American strategy came to be the problem of how to secure victory in its desired fullness without paying a cost so high that the cost would mock the very enterprise of waging war."

Tilford said, "Where war is concerned, American culture is particularly beset with contradictions and paradoxes." He proceeded through a historical survey starting with the assumption of a moral certitude in the earliest days of American history when "thinkers" believed warfare resulted from greed inherent in aristocratic ruling classes, to the emergence of democracies and the predominant belief that war would, with an empowered people, simply pass away. Then there emerged the belief, paramount in the 19th century, that industrial and capitalist interests - especially the arms industry - are to blame for war or that misguided politicians and diplomats are to blame.

Tilford believes this idealistic stream in American culture coincides with today's fascination with technology. The tendency to look to

technology as a way of relieving suffering on the battlefield often backfires, as the use of gun powder in our own civil war or flying to the enemy's heartland to destroy the industrial war-making capability in World War II demonstrated. He noted, "We Americans have a difficult time with war. It is absolutely not a new thing to look to a marriage between idealism and technology as a way of lessening violence. Today however, there is a renewed optimism that technology can lessen the horror of war."

"Identifying the potential enemy for 2025 becomes a major issue. It is highly unlikely that Russia and China will become anything like a peer competitor for the US. Even as the 20th century draws to a close, no potential enemy is attempting to build the kind of Revolution in Military Affairs forces we envision for the US in 2025. A number of nations will, however, use technology selectively to enable them to act asymmetrically. The greatest danger facing the US today is not that we could be surprised conventionally, but rather, because we seem intent upon building a US defense establishment that will be absolutely preeminent in force-on-force combat, we may be surprised by the nature of our most likely enemies. These will include warlords, international drug and criminal cartels, cyber bandits, tribal chiefs, and terrorist groups. These are precisely the kinds of foes who thrive in second and third tier groups where social, economic, and political disorder present the kinds of opportunities that they can exploit. In this world tribal warriors with access to the internet will use cell phones as well as conventional tribal means of communication to coordinate. Countries which a generation ago struggled to obtain and assimilate WWII vintage weapons will possess weapons of mass destruction and will employ conventional means of delivery like planes and missiles, as well as innovative means of delivery like taxi cabs and rental vans. Terrorist groups will complement and enhance their traditional means of brutality with information age resources. The sure thing is that the world of 2025 will be very different from the way we envision it in the late 1990s."

The question is: "will these two distinct influences on American culture, our historical moral certitude and our quintessential faith in technology, come into conflict or even change?"

Today, fewer and fewer Americans have any memory of Vietnam and the WWII and the Korean War generations are shrinking rapidly. By 2025, the Gulf War will be a distant memory. The expectation of quick and near bloodless victory among a population increasingly out of touch with the often bitter realities of the military could prove detrimental. It has been suggested that the availability of precision guided ammunition could indeed mandate their use. The assertion being that rich nations would have a moral obligation to use precision guided missiles (PGM) as a way of limiting collateral damage to non-military structures and minimizing the civilian non-combatant casualties. Presumably others would face no such obligations. Since PGMs can be very expensive, the implications for American defense budgets would be enormous. Furthermore, instead of providing an advantage, our reliance on PGMs would offer our most likely enemies the relatively easy option of dispersing their forces to compel us to use up our precious limited supply of expensive precision weapons. When they were gone, the enemy could simply overwhelm our forces.

Another part of the equation is our cultural environment. Tilford suggested that "by 2025, well over a generation of Americans will have been educated in high schools and colleges where politically correct 'intellectual pablum' may have destroyed their abilities to think critically and reason objectively. The moral relativism issuing from our mainline religious institutions will have long diminished any distinction between right and wrong. How can a people assume world moral leadership when they are themselves lacking a true moral compass? It may be far more difficult to reconcile Dr. Death with a mega-urban sprawl on an environmentally correct geological pertuberance than it ever was to come to grips with the paradox of the horrors of war and our certainty that God had a purpose for this nation."

To demonstrate his concerns, Tilford asked "How, for instance, can we expect a future drill instructor to prepare her recruits for combat if she cannot demonize the enemy? Do we want our soldiers in 2025 to go into combat feeling empathy and compassion for narco-terrorists? Do we want our soldiers filled with sensitivity toward the point of view being held by terrorists who are not in the least bit averse to torturing their captives and quite possibly televising the event? If such a thing happened today as happened in 1941, Americans would react with an outpouring of hatred for an enemy demonized to the point that their extermination might seem appropriate. But in 2025, the reaction might well be to retreat into a national group hug led by a purple dinosaur."

"What can be done?" asked Tilford in closing. "As a nation, we have to proceed into the 21st century with what we can bring to the table. What we can bring to the table is a significantly large population of older citizens, a national fascination with victimization, a people inclined to instant or near instant gratification, an obsession with equity and outcome rather than equality of opportunity, a culture focused on the symbolic rather than the substantive, and a near certainty of declining defense budgets. They will be as much a part of the reality of the next three decades as the information explosion and the revolution in business, medical, and military affairs. Two things are clear; first we are a long way from the moral certitude of John Winthrop and, second, technology without a moral compass to guide its development and employment is a frightening prospect."

Selling Landpower in a Technology-Obsessed World

Dr. John Hillen, the Olin Fellow for National Security Studies at the Council on Foreign Relations' Washington Office, addressed the need and method of selling the Congress on landpower and the Army After Next.

Currently, there are two basic tactics that the Army uses to sell landpower. The first tactic is to make the case that landpower is the force you need for the labor-intensive full spectrum of operations; everything ranging from peace keeping to peace enforcement to humanitarian relief. According to Hillen, the cynics on Capitol Hill perceive this approach as "don't take away my end strength because we will need all these soldiers that get hopelessly mired in the many Bosnias, Haitis, and the Somalias of the post Cold War world. This has not been a big political selling point in the current climate on Capitol Hill. This was ultimately crippling for the Army because it reduced the concept of landpower from a decisive force focused on the most pressing strategic needs of the nation to an overstretched and undertrained constabulary force. Warfighting requires a focus and a sense of urgency on behalf of the nation. It's not a matter of whether you do one or the other, we'll always do the whole spectrum, but really it's a sense of focus. Using this tactic to sell landpower deprives us of that focus."

The second tactic the Army uses in selling landpower is approaching landpower in the context of landpower versus airpower, or to a lesser extent, versus seapower. Hillen demonstrated his point by stating "The Air Force argues such things as airpower today can be everywhere it needs to be at once, can make its presence felt quickly and decisively and none of this can be said for land or surface forces. The Army responds by noting you can bomb it but you always have to send your young men into the mud. Airpower advocates come back by moving into the future and suggest that the Gulf War foreshadows an end to any need for Armies to plan for close maneuver ground combat. It will even foreshadow an end to any need for the Air Force to plan for close air support. At which point the Army, having watched the airpower push even further into future, retreats into the past and says 'no, this proves that landpower has an immutable nature, it's unchanging,' and it will always be necessary."

Hillen believes "The landpower defense is precisely that. It is defensive! It is historically and strategically accurate. It is lyrical and

inspirational. It is also totally bankrupt and ineffective as a political strategy. First, it presupposes that the body politic has a fundamental appreciation of strategy in history. We know that landpower is the decisive element of military force in both peace and war, whether it is for deterrence or peace operations, and that air and seapower, used alone, have an ephemeral and transitory effect, whether you are talking about peacekeeping or warfighting."

The second reason this tactic is flawed, according to Hillen, "is it looses sight of what I call the prom-date nature of the American political system. Who would you rather take to the prom? Would you rather take the air and seapower advocates who offer instant gratification with no commitment or would you rather take the dogged and persistent sacrifice and interminable commitment by those landpower advocates? That is a no-brainer on the Hill!"

Hillen then talked to some additional issues requiring consideration, *e.g.* political reasons, such as pork projects being far more closely related to air and seapower than to landpower projects. He considers these to be tactical problems which can be solved. The real problem, as he sees it, is that "landpower advocates, even the futurists, have accepted the terms of the debate from the other side. The solution is that landpower needs to be presented as the most technologically aware facet of warfare." This approach should be in addition to the traditional methods, which need not be abandoned, but which can be sold more vigorously.

Hillen proposes that "landpower can be sold as the most technologically aware mode for a number of reasons, but principally because of culture. It is much less a cultural shift, in terms of institutional cultures, to modernize, even in a revolutionary sense, approaches to land warfare than it is to modernize in the other services. Additionally, modernizing land forces is not going to cost nearly as much as it would cost to revolutionize sea power and airpower. And finally, the technologies are here. A revolutionary approach to landpower is going to happen in the context of several

movements; organization, doctrine, strategy, and culture. Technology is just one component. We can move now to organize for revolutionary concepts in land warfare with the technologies already coming on line at this time."

So, the specific plan proposed by Hillen "is to take the 'After' out of AAN. Make the AAN the Army Next. The revolution is going to be much more than technological, it is going to be mostly organizational and doctrinal. 'Slapping a 486 computer on tanks in a division that is organized in Napoleonic form is putting electric lights on a horse calvary. While you will get some modest improvements, they are not revolutionary in any sense.' We can transition now to new organizational forms and doctrine and bring the technologies on line to fully realize the revolution. Force XXI should consolidate its present gains, and the Army should move directly to the concepts in the AAN."

"There will be obstacles from members of Congress and the public," acknowledged Hillen, "but those will simply have to be worked through. We may need to change the terms of the debate and the terms of battle. If the existing terms of the debate continue to be accepted, defeat is inevitable in the current climate. Down the road, there won't be enough Army or enough budget around to transform to the AAN and it will be so late in the game that we will have already bumped up against challenges in the international strategic environment that are sure to arise in the next 25-50 years."

Personnel Synchronization for the Army After Next

Major Michael Stehlik, currently assigned to the Office of the Chief of Staff of the Army where he conducts strategic personnel analyses, suggested that the Army experienced its second largest recruiting failure in the history of the All Volunteer Force in fiscal year 1997 in spite of lowering accession standards and adding hundreds of recruiters and over $50 million to the US Army Recruiting Command's budget.

If this incident were sufficiently explainable, then, although undesirable, it might warrant little further action. If, however, the explanatory variables do not exist or if they insufficiently explain the failure, then this incident should be examined in a broader context. But the Army has no process to evaluate the confluence of many singly benign social trends across many succeeding cohorts to determine what impact they may have on the Army's ability to successfully attract the appropriate number and quality of new soldiers.

The Army After Next comes to fruition *circa* 2025 by using leap-ahead technology creating a force characterized by "Knowledge and Speed." The people necessary to make knowledge and speed a reality in the AAN will be the same people the civilian sector will seek to employ in the 21st century. However, by 2001, a seventeen-year old would make more money at a minimum wage job than if he were an E2 in the Army. Successful manning of the AAN is not a given.

Consequently, the Army should monitor the trends in society because they have military implications. The Army should develop and implement a process that synchronizes the activities of organizations and systems to provide senior leaders the information they need to successfully man the current army and bring the Army After Next to fruition. This process should be robust enough to evaluate many irrelevant data and identify the critical pieces of data.

Major Stehlik then described an existing Army process that provides commanders militarily relevant information of the battlefield. He suggested the Intelligence Preparation of the Battlefield (IPB) could be adapted to this issue in the form of "what I call the Personnel Synchronization Plan, or PSP." He went on to discuss specifics such as identifying the command to make use of the PSP as the Army's senior leadership, the course of action as bringing to fruition the Army After Next force, to include successfully manning the Army, and identifying who should be the Army's collection manager.

To further the adaptation, Major Stehlik talked about the identification of decision points and activities that have military personnel implications on the "battlefield." He said "The PSP's planning horizon should extend as far out as the Army is planning a force *i.e.* at least through 2025. Remembering that there are numerous organizations already involved in the civilian-to-military transition there are natural decision points that take advantage of their expertise."

Using various criteria, he designated age group decision points as those seventeen to twenty-one years of age, twelve to sixteen, four to eleven, and all younger than four. Having identified the decision points, he went on to identify what should be monitored at these decision points, or what is the 'named area of interest' (NAI). He concluded that, "From a review of the literature there appear to be five broad NAIs: Aversion to Standing Army, Willingness to Serve, Economics, Military Isolationism, and Moral, Physical and Cognitive Stock of Society."

According to Stehlik, "The primary purpose of the PSP is to synchronize the materiel developers, force developers, and training developers by providing a validated set of facts and assumptions describing future personnel. Additionally the PSP should provide early warning of potential difficulty in meeting a planned endstrength. Lastly, it should be the tool identifying 'gaps' in the commander's knowledge that the studies program should be used to fill."

In order to review the NAIs and assess the near term and long term impact on recruiting it is important to understand what the Army After Next soldiers' attributes may be. AAN planners conclude that the junior leaders are the ones who must possess the cognitive capability to accurately process a dizzying amount of battlefield information while simultaneously enduring the stress, fear, and increased physical isolation associated with an increasingly lethal battlefield in 2025.

The Army's response to technological revolution is not new - quality people. In 1875 Major General William T. Sherman envisioned that "the companies and battalions will be more dispersed, the men will be less under the immediate eye of their officers, and therefore a higher order of intelligence and courage on the part of the individual soldier will be an element of strength." Some state that as battlefield uncertainty increases, then the need for smarter, aggressive, independently thinking soldiers also increases. Regardless of how a generation views technology's impact on them, either evolutionary or revolutionary, quality soldiers - characterized by initiative, courage, aggressiveness, improvisation, and intelligence - are the enduring basic building blocks of an effective force.

Keeping in mind these enduring characteristics of the quality soldier necessary to bring the AAN force to fruition, Stehlik assessed the Army's ability to attract sufficient numbers and quality of new soldiers in the near and long term.

Stehlik said, "The first NAI attempts to measure the impact of America's long standing aversion to sustaining a large standing army during times of peace. One only has to look at the size of the Army and overlay it with the periods of peace and war. There are two exceptions to this pattern: the Cold War and today. During the Cold War, the public sufficiently believed that the United States was at war to justify a large standing military. Today, however, the government has not convinced the public that there is any credible threat justifying a standing army of one million plus people. In the near term, does this aversion effect recruiting? The research is not conclusive but it appears to be a hole in our 'knowledge' of the environment."

"Willingness to serve could also be a significant hurdle to successful near and long term recruiting," Stehlik postulated. "As mentioned earlier, willingness to serve really answers the question 'Will a society that is discontent with its government voluntarily supply their sons and daughters for military service?' Our public life is rife with

discontent. Americans do not believe they have much say in how they are governed and do not trust the government to do the right thing. If and how does this discontentment with society and our government affect society's decision to support the military with their children? If people generally do not acknowledge any higher authority, how does that impact on their willingness to serve in the military? If Americans' desires to fulfill basic civic responsibilities continue to wane, how much more reluctant will they become to serve in the military? These questions represent 'gaps' in our knowledge of society and if and how the answers effect recruiting."

"Some also argue," Stehlik said, "that as the United States moves into a post-modern society, loyalty to the nation-state will decompose. America will become a multi-cultural regime not a nation-state. In other words, America will become a 'mixing bowl' versus a 'melting pot,' where citizenship is merely a baseball cap that can be donned or removed at will. Who is responsible for defending a 'multi-cultural' regime? When? If, in fact, the United States is headed for this, what are the implications on manning the Army?"

Finally, Stehlik advanced the concept that "the current civil-military economic exchange ration may well explain a large portion of the recruiting difficulty. The economic benefit of military service, relative to college followed by civilian employment, is continuing to fall further behind, indicating that the Army may not be a good place to start. While the wage premium for those with 1-3 years of college has remained relatively constant in relation to that of a high school graduate, those with four year degrees have seen their wage premium grow from 140% to 160%+ over those with high school degrees. The increasing college wage premium is actually leaving the Army a lower quality pool of applicants from which to recruit; high quality youth who previously enlisted in the Army are now attending college."

Additionally, consider the impact of the lowest unemployment rate in 24 years on potential applicants choosing the military versus civilian

employment. It is forecast that the unemployment rate will remain near these levels. How will this effect recruiting in the near term?

What are the long term impacts of a continuously increasing higher education wage premium on the Army's ability to man the AAN? To attempt to answer this, Stehlik asked, "what is driving the wage premium and can we determine if and how that will effect the Army's ability to man the AAN force?"

"First," he said, "pushing the 'go to college' rate is the effect of technology on the cost of human capital." Information technologies are now reshaping the workplace in two ways: smart machines and intelligent tools. Smart machines take control of the job, telling the worker what to do next. Intelligent tools technology provides workers with powerful capabilities to be utilized as they choose. Smart machines de-skill jobs, reduce salaries, and make work more mechanical. In contrast, intelligent tools increase effectiveness, increase skill of jobs and drive up their salaries. Both the Army and the civilian employers realize they will need the same quality employees. Given the previous discussion on economics, the Army does not appear well positioned to attract them onto active duty.

"Military Isolationism is the fourth named area of interest that appears to have at least near-term impact on recruiting. Given that over half of the enlisted force had a father who served or is serving, and that rate was over seventy per cent in the officer corps, how much more difficult would recruiting be if former service members tended to encourage other post-high school employment? Our 'knowledge' in this area is not as conclusive as it needs to be given the possible ramifications."

Some find today's society at odds with military values of sacrifice, unity, self discipline, and teamwork. Still others assert that not serving in the military became the moral thing to do once the All Volunteer Force was created in 1973. What are the implications on the military if, morally, it is 'ok' not to serve?

Charles Moskos contends that the decline of military service as a gate for those bound for elite positions in society is the most important reason for the widening gap between the military and society. This estrangement was exacerbated with the current administration's lack of military service. What is the impact on society when its elite does not serve? We do not know the answers to these questions, but we should.

The last named area of interest addresses the impact of the moral, physical, and cognitive aptitude stock of society as it affects the military. The Boy Scouts of America conducted a nationally representative survey that concluded "such values as citizenship, patriotism, or social responsibility are assigned considerably less importance by teens age 14-19 than by younger boys." On men, the survey concludes "the ethical and moral values of many men fall short of the ideal and reflect a degree of cynicism about society." What are the implications for the military of declining moral stock among men and women in society? In the near term, the Marines extended and toughened their boot camp. In the long term, it is unknown.

Like many of the other trends mentioned, aptitude trends are also working against the Army in both the near and long term. There is evidence suggesting that, despite increased college attendance, proficiency levels among both college and non-college bound youth is not increasing. More importantly, though, there may be more 'inequality' in the quality youth market that these statistics do not capture. Consequently, there may be a smaller pool of 'quality youth' acceptable to the military, civilian employers and colleges. If so, and given the previous discussion of the impact of technology on jobs, it is aphoristic that the Army will face stiff competition for the high quality youth necessary to man the AAN. However, for the Army to effectively muster the necessary incentives to be competitive at attracting quality human capital it first needs to understand the environment in which it expects to 'fight.'

In summary, we can conclude that near term recruiting success is in danger; however, this danger will be substantially masked by drawdowns in recruiting missions in FY 98 and FY 99. Of the relatively widely known factors affecting recruiting mentioned earlier - economic conditions, civilian competition for quality, and moral, physical and cognitive aptitude levels - all will continue into the next few years as they are today. The Army's response of increased enlistment incentives has not had the expected results because there was more to the FY 97 recruiting shortfall than our existing models and theories explain. However, by including the 'soft' NAIs in the PSP - aversion to a standing army, lack of willingness to serve, and military isolationism - then the claim that near term recruiting is in danger appears valid and persistent.

As near term recruiting will remain difficult, the Army also appears to be in a tenuous position to bring the AAN force to fruition. The most problematic issue appears to be that the Army, colleges, and civilian employers will be actively pursuing the same, and possibly a dwindling, group of high quality youth. Additionally, the waning of civic responsibility and the rise of a multi-cultural regime replacing the traditional nation state also bode ill for the Army's ability to bring the AAN force to fruition.

Questions & Answers

Seth Weinberger, with the Strategic Assessment Center of SAIC, posed a question for Dr. Tilford. "Driven by this new desire for global internationalism, we're seeing right now a big drive to control a lot of weapons and to ban them. We have seen chemical treaties and landmine treaties so I wonder where you might see this going into the future? As new technologies appear and as the military adopts these new technologies, how do you think the American public and world opinion is going to impact the military's ability to develop and integrate these new technologies? Will we see efforts to ban them?"

Dr. Tilford responded "I think it's going to be a problem. Look at how we've used technology and at the resulting outcries. As we become more and more technologically sophisticated and these weapons of tremendous technological capability come in, any enemy who doesn't paint us as unfair, immoral and who doesn't try to get sympathy for this is shortsighted. That will then be fed right into American society because that is what sells on television."

Dr. Frank Hurley, ARO, said, "Maj. Stehlik, I think you've done a great job of reciting the problems and discontents and asymmetries and so on that exist in American society now. I wonder if one conclusion could be that there is no power on earth that can prevent a really large reaction to that situation and that, if we're really doing future studies, we should look for a national position all the way on the other end of the spectrum. Such reversals have occurred regularly in American history. Why do you not now think that an entire reversal won't occur and that we may have to cope with a very different set of circumstances, especially if we're looking out to the 2025 time frame?"

Major Stehlik responded "The great thing about being a futurist is everybody's right. By the time we get there we have either forgotten what was said or we are all dead. I think what we need to do is explore broadly some of the alternatives that could take place and then see if we can figure out what can we still live with. Maybe reversal is something we ought to consider in the broad spectrum."

A questioner from the floor, for Major Stehlik, wondered "if anybody is looking at alternatives to the standard 20-30 year career path or even the 2-4 year enlistment for that matter. It seems that if we assume we are going to be an information based society and knowledge is going to be most important, it will take a much longer time for individuals to get to that level of competence. That knowledge or level of competence is also going to be shorter lived. Maybe we need to think of ways to bring in soldiers and officers who will serve in periodic episodes punctuated by some kind of education or training or

civilian employment before being brought back in. In other words, break the model that we currently use which, apparently, is the only model personnel specialists are considering for the future force."

Stehlik responded "there's a tremendous amount of energy being spent right now trying to figure out all the possible things that could happen. OPMS is an attempt to do that. There is considerable discussion about how to find the extremes and then pass that off to the subject matter experts or to the researchers to find out what happens if we institute, say, a vested program at 5 years."

Another questioner from the floor addressed Dr. Hillen: "I am interested in your ideas about Congress. It takes two to make this thing work as far as how we are going to evolve into the future. They're going to have to make the key decisions as far as weapons systems, *etc.* What insights can you offer into what ideas Congress would be willing to listen to. Right now, there doesn't seem to be much interest. I've tried to follow the work of the Army caucus, and I've found almost nothing going on there."

Hillen responded by suggesting that the Army senior leadership is not doing well at selling Army needs to Congress. He sees Army general officer "personalities that are reactive as opposed to proactive. The other services recognize that it's generally a zero-sum game on the hill. That's helpful, and they can do that in a collegial way. They simply recognize those to be the terms of battle up there. They are also proactive. They are out there working the community. When there is a big Navy program up on the hill, the best looking guys in the Navy are cruising the halls - articulate, intelligent officers talking and chatting up, working the system. That's effective. I'm not saying the Army needs to prostitute itself in a salesmanship way, but it needs to be more of a cognoscente in the system. There is a whole community of opinion makers in Washington that the other services ceaselessly network. Other services seem to be more aware, whereas the Army seems to feel that it should just be self-evident to everyone that America should have a large standing Army. I say it's not self-

evident at all, especially to the new generation. So they need to get out of that box and recognize and accept the terms of battle as they have already been set."

The Future of Coalition Warfare

Technological Advances and Coalition Warfare

Dr. Steven Metz, the Henry L. Stimson Professor of Military Studies at the U.S. Army War College, has been with the War College's Strategic Studies Institute since 1993 and specializes in future warfare, U.S. national security policy, conflict short of war, and strategic theory. *No transcription of Dr. Metz's presentation is available. In its stead, the published summary of his paper, co-authored by William T. Johnson, Douglas V. Johnson, James O. Kievit and Douglas C. Lovelace, Jr. and originally published in Parameters under the title "The Future of American Landpower: Strategic Challenges for the 21st Century Army," is reproduced here in its entirety.*

The global security system of the early 21st century will be configured into three tiers, each defined by economic form and degree of governability. The first tier will include the technologically advanced states of Western Europe, North America, and the Pacific Rim. Intense economic competition may occasionally lead to political conflict and even spark full-blown information warfare, but there will be no traditional warfare within the first tier. Second tier regions will retain most features of Cold War era nation-states. Periods of rapid internal political transition will occur cyclically and often will be violent. Second tier states may occasionally resort to conventional interstate war and will retain large land armies equipped with some sophisticated weapons systems. Many of them will develop weapons of mass destruction. The third tier will experience ungovernability, occasional anarchy, endemic violence, severe ecological degradation, the politicization of primal loyalties, and political fragmentation. Third tier states may engage in short, spasmodic wars with each other.

Interdependence will be the defining characteristic of the future global security system. Because of interdependence, the global security system will continue to experience cycles with periods dominated by violence followed by widespread resolution of conflicts. The goal of the United States, the only power involved everywhere, will be to take maximum advantage of periods of peaceful conflict resolution and to shorten periods of violence. American landpower can play a key role in these efforts.

While the internal dimension of American security will probably change less over coming decades than the external one, several trends are important. Political leaders and the public are likely to remain intolerant of protracted or costly military ventures except when crucial national interests are clearly threatened. Pressure for near total disengagement from the third tier will be particularly strong.

If the future security environment takes the form just described, five strategic challenges will be most important for the Army:

Reconcile long-term and short-term imperatives. Strategists must maximize the chances of long-term success while minimizing short-term risk. If the future global security system is relatively benign, the Army can minimize the resources it devotes to long-term modernization and force development. But if conflict dominates the future global security system, the United States must accept greater short-term risk and focus on force development and modernization. Current American strategy may be slightly skewed in favor of the short term.

Maximize efficiency. American military forces will remain small in comparison to the number and scope of tasks they will be given. This creates an overriding need for efficiency. One way to augment efficiency is through coalitions. Technology probably holds greater promise of bringing dramatic improvements in efficiency, but it requires extensive investment. Reliance on technology also can generate unintended adverse effects. New technology can make current (and expensive) technology obsolescent. Or, challengers might seek low-tech, asymmetric responses to counterbalance the American advantage.

Maximize the political utility of landpower. A military force has political utility when political leaders and the public deem the expected costs acceptable. It is impossible to predict precisely what the American public and its leaders will define as acceptable costs in coming decades, but Army leaders must be aware that this fluid

equation can change rapidly, and the type of force they create, train, and equip must, in part, be determined by the need to maximize political utility.

Undertake a controlled institutional revolution. The historical boundaries of landpower may be stretched as the basic concept of national security expands to include, for example, protection against violent threats to national information and information systems, the environment, and public health. The Army must decide whether to expand and accept the new roles of landpower or specialize in one or two functions and allow some other institution to assume the new roles. Phrased differently, the Army will have to decide whether warfighting is the function for which it exists or simply one function (*albeit* an important one) among several.

While the *need* for a controlled institutional revolution in the U.S. Army is becoming clear, its precise direction is not so obvious. If the functions of landpower continue to diverge in terms of the skills, concepts, and organizations they require, it will become increasingly difficult to craft a military organization that can perform all of its required tasks. If tasks other than warfighting become more strategically important, the relationship between the Army's warfighting component and its peace operations/ conflict resolution/ grey area threat component may need radical change.

Preserve public support for effective landpower. To retain the public support necessary for continued investment in landpower and for recruiting from a shrinking pool of candidates, senior Army leaders must persistently and convincingly explain the roles that landpower plays in deterring violence, defending against aggression that does occur, reassuring allies and friends, and helping resolve conflicts.

As senior Army leaders explain the enduring significance of landpower to political leaders, the media, and the public, they must counter several popular myths concerning American strategy and the role landpower plays in it:

• That the United States can disengage from the conflict-prone parts of the world, thereby obviating the need for direct involvement.

• That the world will see no more conventional wars.

• That allies or international organizations can compensate for a decline in U.S. ground forces.

• That landpower can be allowed to atrophy during the current period of fragmented threat, and be reconstituted if necessary.

The current Army leadership recognizes the need for fundamental change. But this is only the first (and easiest) step. The next one is to reach consensus on exactly what the most pressing strategic challenges are. This essay has suggested five. The development of coherent programs to deal with these challenges is the greatest legacy that the 20th century Army can leave the nation.

Peacekeeping and Beyond: Shifting Coalitions Futures

Dr. Donald M. Snow, professor of Political Science at the University of Alabama, believes that, given the validity of the observations that the majority of future US military involvement will be in civil or internal conflicts, and that in each of any such involvements a shifting cast of coalition partners will be paramount, there is much yet to be understood by the decision makers. The questions Dr. Snow feels are most important to answer include: first, the nature of these kinds of conflicts, including those bedeviling factors that make successful resolution and hence conclusions of missions difficult; second, whether the United States or its major partners have any business becoming involved in these kinds of conflicts - a question of interests; and finally, the nature of involvement in these new internal wars on those occasions where involvement is deemed necessary. *In the absence of complete audio transcription of Dr. Snow's remarks, a*

combination of the available transcripts and significant excerpts from the paper on which his remarks were based are reproduced here.

As to the nature of this new internal war, a first characteristic is that it does not conform to the patterns associated with "traditional insurgency" during the Cold War. The most prominent variety, which Snow calls "the *criminal insurgencies* of east and west Africa, seem to proceed with hardly any political goals at all, save possibly the creation of a condition of anarchy that facilitates the systematic looting and plundering of the countryside. This is as close to a political purpose as one can divine. This absence of discernible positive political purpose is generally accompanied by apparently senseless, undisciplined and wanton violence. The new internal wars are hardly wars in any conventional sense."

The pattern of these conflicts geographically and demographically forms a second characteristic. Dr. Snow suggested "they tend to occur in so called 'failed states' in areas outside the globalizing economy. As such, they tend to be both politically and economically impoverished countries. From this it is concluded that the problem is usually far deeper than the dying shows; the physical outburst is really little more than the symptom of a far deeper and more serious underlying problem. In most cases, that deeper problem is economic and political poverty and despair."

"These conflicts," according to Snow, "exist on two distinct levels, and responding to one level does not necessarily affect the other. The surface level, the symptom, is violence and suffering and we have become reasonably adept at responding to that level, as demonstrated in Haiti and Bosnia. Making the combatants stop killing one another does not, however, necessarily address the second, and more fundamental, level, which is the political and economic impoverishment of the states that has bubbled over into vicious violence. That is a problem of *state building,* which is a much more arduous task made more difficult by the location of these wars outside the growing prosperity of the globalizing economy. If one is going to

'create' hope in Somalia or 'assist in the creation' of democracy in Haiti, state building is what must occur. It is not at all clear that we have the will, or the interest, to pursue the task of state building."

Judged by the criterion of vital interests, United States involvement in the chaotic new internal wars could hardly be justified. One way to look at United States, and others, inaction in Rwanda, for instance, is that no matter what the outcome, hardly any Americans or the interests of the government were affected. Stated this way, the criteria of the Cold War may seem cold and bloodless, but they did provide a durable way to think about and react to international stimuli. Oddly, the Cold War competition did provide reason to become involved in situations which, in a post-Cold War environment, the realist paradigm criteria would cause us to avoid now. The variable, of course, was the competition itself. Countering the spread of Soviet communism provided an interest in the violent politics of, say, sub-Saharan Africa, where no other interests existed.

With that justification absent, the same criteria say we have no business there. Support for and the subsequent dumping of Mobutu is eloquent testimony to the difference a Cold War makes. In other words, in these kinds of conflicts decisive outcomes can scarcely ever be expected. Rather, little improvements in the conditions may be all we can hope for, unless we are willing to stay the long haul and state build (a dubious prospect that we will examine in the next section). The question is whether small outcomes are enough to justify any involvement.

Are we ready to make such a transition? Without a modification of the realist paradigm, including a redrawing of the line where interests are depicted separating when force will and will not be invoked, the answer is clearly no. The only way to legitimate the use of force in non-vital issues is to broaden the definition of interests eligible for forceful solutions to include non-traditional instances and circumstances.

There has been no national debate on this issue, and there probably will not be. *The National Security Strategy of the United States,* in its 1997 edition, put forward such a broadening by including "important" and "humanitarian" interests among those kinds of situations that might merit some use of American forces. This expansion has not been subjected to close public scrutiny, and likely will not be until such a time as a sizable number of American reservists are activated in the name of an international response to a new internal war in some especially obscure place.

It is clear that there will be international efforts mounted from time-to-time, and most of them will probably at least be legitimated by the United Nations through some form of Security Council Resolution. It is also clear that the United States will be expected to play a role in these efforts, although that role will undoubtedly vary. The resulting missions will be complex and difficult to manage because they will involve coalitions that will vary in the national constitutions of forces sent and, in many ways more difficult, in the range of institutional actors, both local and international, with which the military side of the mission must deal.

One of the major characteristics of the post-Cold War management of international systemic violence is the prominent role of the United Nations. Although not enough precedent is available to speak with great confidence, the Desert Storm and Bosnian experiences, in tandem, suggest a likely pattern for the future. Both point to the strengths and limits of the UN. The response to the Iraqi invasion of Kuwait was a series of gradually strangling resolutions which, in effect, deputized the United States to organize the coalition that faced Saddam Hussein. For the US, which almost certainly would have reacted unilaterally in the absence of a coalition, UN blessing served the dual purposes of legitimating administration policy and effectively hamstringing congressional reluctance about the adventure. UN imprimatur probably also increased the size of the coalition.

Two things are evident from this - one positive, one cautionary. The first is that UN legitimation provides a way to organize international rather than unilateral responses to crises (or to decide *not* to mount such responses). It also means that once a mission is organized and put in the field, there will be a UN presence, at least in the coordination of nonmilitary activates provided by intergovernmental organizations (IGOs) and nongovernmental organizations (NGOs). If military missions can learn to use the UN as a buffer between itself and the "care givers" that IGOs and NGOs provide, the result will be positive. On a more cautionary note, the UN is almost certain to conceptualize these situations as peacekeeping and to try to impose the peacekeeping model on situations where that typification will be inappropriate - especially at the military level.

The two examples raised share another characteristic: the central role of the United States. It is, for better or worse, an axiom of the United States' central role in the system that much of the world looks to the United States for leadership when difficulties arise. It is a legacy of being the world's remaining superpower that the world expects the US to act, even though it must consciously act as a non-hegemon because the role of the US as a hegemon would be opposed by the system and because the US lacks the power to enforce this role anyway.

This role does not mean either that the system will always appreciate, agree with, or follow American leadership or that the United States will always or necessarily be a prominent part of all missions that arise. The recent flap over inspection of suspected Iraqi weapons-producing facilities elicited an American proposed military alternative that sent the members of the old Gulf War coalition diving for cover, at least publicly, which should not have been very surprising.

Although American leadership and backing are necessary for most international responses, this does not necessarily mean that United States forces will have to be prominently on the ground for a successful response. However areas where direct American assistance

is necessary for an operation of any size and complexity to succeed are in transport and logistics and intelligence. But to say the United States will not always be in the thick of these missions militarily is not to say that we are likely to be off the hook in any of them. In addition to the presence already mentioned, there is almost certain to be an American political and economic presence, as well as some military presence. This means that there will have to be cooperation among a plethora of local, American, and international organizations in these situations. One can think of these missions as having two distinct phases. In the first, the role and mission is to reestablish the peace, and it is primarily military in character. After employing minimal force in Somalia and seeing that fail, the Haitian and Bosnian precedent of putting an intimidating amount of force on the ground suggests that this phase can be accomplished fairly quickly in most circumstances.

The second phase - trying to construct, or reconstruct, some sort of order that can be maintained after outside intervention is terminated - is the more complex and stressful, because it entails state building where political and other nonmilitary skills transcend military attributes. In essence, the military role diminishes to providing a shield behind which the healing actions are carried out.

In this second phase, four distinct sets of actors will come into play. All of them will have different perspectives on the problem and its solution and many of them will harbor suspicions about the others, both personally and professionally. Yet all of them will be expected to act together if some stable form of peace is to be the outcome. The four sets of actors are: the military (for our purposes, the U.S. military and its military coalition partners), political authorities from the intervening states (for our purposes, American authorities), international actors (IGOs and NGOs which, for some purposes, are separate and not necessarily compatible actors), and officials (where they can be found) of the country itself. This is a formidable combination of forces that is almost certain to operate at cross purposes some of the time and to view its "partners" with some level

of suspicion. Yet each has a primary role which must be coordinated with the others for a stable peace to be the end result.

The primary role of the military component, obviously, is to establish and enforce a cessation of hostilities. Once the shooting has stopped, the natural emphasis will be on creating as physically secure an environment as possible, and it will naturally be reluctant to engage in actions that might put its forces at any more risk than is absolutely necessary. Garrisoning and patrolling secured areas is its preference; foraying into areas where trouble still exists is not. Creating a nonviolent ending of the first phase is its clearest mandate and the one which it is likely to feel most comfortable carrying out.

Political authorities from the countries providing forces represent a second part of the overall coalition package. From the United States, this is likely to mean representatives of the State Department - either professional diplomats on the scene or special envoys. Their purpose is, generally speaking, twofold: to help arrange a political accord among the formerly warring parties (where leaders with whom to negotiate can be identified), and to try to negotiate terms of settlement that will facilitate the state building process (for which they will be expected to provide the primary expertise).

International organizations, both intergovernmental and nongovernmental, form the third part of the package. IGOs will generally be arms of the United Nations or be the UN organization itself. Their overwhelming interest is in the promotion of peace. Their role will be self defined as coordinating the efforts of all others, especially when the mission flies the powder blue flag of the UN and personnel are adorned in powder blue baseball caps or helmets.

The NGOs are one of the most interesting but least understood parts of the equation. Generally, they are of one of two persuasions and functions. The first are the *care givers,* those organizations whose primary mission is to relieve the suffering of the population: food providers such as CARE and medical providers such as Doctors

without Borders are obvious examples. Generally, the care givers are the first outsiders to arrive to dispense aid and they remain on the scene after the rest of the outsiders leave. The next groups of NGOs are the *monitors,* groups whose primary mission is to observe what is going on and to report violations, especially of human rights. The prime examples are Amnesty International and Human Rights Watch.

The last such groups are the local authorities. In these situations, there is generally some confusion (or at least competition) over who these people are, which is a prime reason there is a conflict in the first place. Unlike traditional insurgency, there is unlikely to be a functioning government with which intervenors can coordinate; instead, they must try to identify factions and leaders at the local or national levels with whom they can communicate. The problem is that determining who these leaders are is not an easy task, especially for outsiders who have less than a full understanding of the dynamics of local politics. Moreover, there will almost always be more than one individual or group which will identify itself as the leadership, if for no other reason than to curry favor with the outsiders in hopes that doing so will assist their quest for power.

Thus, the table is set for coalition formation and maintenance. There are four sides to the table. On one side is the military, which wants to impose peace (at least ceasefire) and to secure the area in question; from the experience of so called "mission creep" in Somalia, it is unlikely to favor aggressive actions that might change the status quo (such as disarming factions in Somalia or aggressively pursuing war criminals in Bosnia), because such actions put their forces at risk. On a second side are the political actors, whose mission is to try to create some kind of reconciliation that will maximize the likelihood of an enduring peace; this requires state building (such as disarming people and arresting war criminals) to *change* the status quo that resulted in war in the first place. The military and the foreign ministry thus come into conflict.

A third side of the table is occupied by the international organizations. In terms of intrusive action, the NGOs are likely to be the most aggressive. They want to alleviate suffering or monitor atrocities wherever they are occurring, which is often outside the secured areas. CARE wants the military to ensure that food and other aid gets through, and Doctors without Borders wants the military to shield against such things as being kidnapped and forced to operate military field hospitals for one or another of the warring factions (as happened in Somalia). The military is likely to be reluctant to provide such assistance, although it will if required. The end result sought by outside political authorities and NGOs is basically compatible, but one is motivated by immediate concerns, the other by the longer haul.

Then, there are the locals themselves. If the pattern that has emerged in the post-Cold War world continues, the intervention will have occurred without any invitation by a constituted government (often because there isn't one). This means that outsiders will have arrived uninvited and, in some quarters, unwanted. The problem for local authorities is to try to establish their *bonafides* and then to make the best of the situation for themselves.

From this intermixture of perspectives and motivations, operations must evolve. In those cases where divisions can be overridden by a common desire to end hostilities and to create an enduring peace, the prospects for overcoming differences in the name of the common end may be reasonable. At the same time, that sort of reasonableness cannot be presumed; if it could, the situation would probably not exist the way it does.

Outside involvement in the chaotic situations of new internal war represent one of the real challenges for the Army of the Future. The senior military leadership has acknowledged that this kind of warfare is going to be the modal form of violence in the near and mid-term. One can add that if this mission is eschewed, then it is not clear exactly what the armed forces will be used for in the upcoming years.

These missions represent a very new, difficult, and likely frustrating prospect for the armed forces. The situations are different from those for which doctrine and training provide. The kinds of coalitions that have to be formed to confront them dwarf in complexity the requirements of "jointness" with which the services have grappled over the past years; learning how to create and sustain positive, productive relationships among very different coalition partners will be a major challenge.

They are also likely to be frustrating. One part of the frustration is going to be getting one's intellectual "hands" around the problems these situations present. Criminal insurgency is not a concept that is easy for Americans to identify with and the motives for genocide are quite beyond us. At the same time, the actions and outcomes are neither very military nor necessarily very satisfying. If this is the face of "post-heroic warfare," it is going to require some adjustment in what constitutes soldiering. Finally, any results that are achieved are likely to be fragile, partial, and reversible. As the last non-American peacekeepers began leaving Haiti on December 4, 1997, the system collectively crossed its fingers. The continuing extension of the mandate in Bosnia is equally clear evidence of an assessment about the reversibility of that situation should the intervening forces leave as well.

Questions & Answers

Question from the floor for Dr. Metz. "I think your thesis on the end of coalition warfare is very interesting, but would you comment on some obvious objections to your theory; first, the political and diplomatic environment will mandate that the US not be seen as acting unilaterally, so will we not be stuck with coalitional partners whether we need them or not? Secondly, there are enough countries out there that like that $997 a month that they get for each person provided for a UN mandated operation that volunteers for coalitions are going to always be there. The third thing is that countries like

France and England, that fancy themselves first world militaries, lack force projection capability. Unless they piggyback on a US operation they will no longer be considered world powers and will not have a 'seat at the table.' A lot of the countries want a seat at the table, and therefore they want to be part of a coalition."

Dr. Metz responded, "I have no doubt that there still will be peace-keeping coalitions in the future, but I think the US will reach a point where it would rather pay for those sorts of things than to involve our military. We'll throw our money into the pot to get it done, but we aren't necessarily going to take our forces and train them for those things when there are lots of others out there that can do it. The US is moving toward a position where we're going to have a military that can do things that no other military on earth can do. We'll rely on the regional structures and on the UN to do the low level things that anyone can do. This will allow us to specialize in the sorts of long range power projection, fighting the big war kinds of things that no one else can do. There still will be the political veneer that gives us confidence that we are on the side of right."

Another question from the floor; "Given what you see as US obligations and responsibilities, as a percent of GDP, how much should we be spending on defense?

Dr. Snow commented "If, when I look out there at the world and ask 'where are the conflicts and peer competitors' and I am not able to find any, the question becomes 'how big a best Army, best Navy, best Air Force in the world do we need?' This is particularly germane if no one else shows an interest in trying to compete with us."

Dr. Metz suggested, "...that becomes a sort of 'Who knows?' because it depends upon whether the environment becomes more hostile or less hostile. Improvements in our military have unintended side effects. What is driving us toward pursuing the RMA in the AAN is response to a number of pressures - to what we see as a long term decline in real dollars in the defense budget plus the desire to minimize

casualties, but we need to stay globally engaged. What we don't consider is that, as we pursue revolutionary improvement in our military forces, others will pursue an equal if not similar type of change. I don't really have an answer in terms of the percentage or the aggregate numbers."

Another questioner from the floor asked, "What about the idea of making a small AAN scaleable so that when we need something larger, we could field it?"

Dr. Metz responded, "Most AAN thinking today assumes that every war this force is going to be in is going to be short and quick and there is absolutely no planning for anything else. If it goes longer than three or four weeks though, this is the way I visualize we are going to do it: bring in the legacy forces, mobilize the reserves that are still in the US, mobilize the cyber reserves that will let us have this expansive communications band that we would need for a full scale war and all of these things. But I assure you that, from what I've seen so far, the whole notion of a surge or mobilization capacity really isn't being discussed."

"Additionally, there always have been and always will be the options of the war production lines. That is, not producing any significant quantities of these new systems that the AAN needs, but having the factories, able to rev up in a hurry, ready to go to a higher rate of production. That capability costs money but it doesn't cost nearly as much as the large scale production. That's been part of our defense budget for decades."

APPENDIX

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